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WITNESS my hand this
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Field of the Invention

This invention relates to locks for displaceable wings, said wings including French Doors, Security Doors and Timber Doors and including hinged and sliding doors.

Background to the Inventions

French doors, as defined below, typically employ a lock having a lock body that is morticed into the frame on the closing edge wing and handle assemblies that are mounted on each side of the wing adjacent the lock body to be connected to the lock body by a shaft. Now days, these doors are often closed against a strip of compressible sealing material located between the door and an element defining in-part the opening and against which the wing closes (this strip being to prevent energy loss) - this action requiring a not insignificant force.

These doors lend themselves to being urged fully closed by the operation of remote locks having plunger-like members that can be driven into receiving apertures of upper and lower elements of the opening.

Typically locks for common French Doors must have a lock body of small depth that is not more than about 40MM, a small setback not exceeding about 30MM, a small width not exceeding about 16 MM, a bolt that can extend at least 15 MM from the lock body and preferably means to displace rods at least 15 MM. Preferably, an industry standard for the distance between the cylinder and lever axii of 85.00 MM should also be observed.

Typically locks for common Security Doors require the lock to have a smaller lock body having depth not exceeding about 40MM, a setback of about 27MM, a width of about 14.5 MM and not exceeding 16MM, a bolt that can extend at least 14 MM from the lock body and preferably means to drive rods at least 11 MM. Preferably, the lock should also comply with the industry standard fitting apertures within the door.

In each case, it is difficult to comply with the space requirements imposed by the conditions described above because bolts needs to extend adequately into the casing when fully extended to be properly supported and this imposes restrictions on integers competing for space adjacent the bolt and because the lock body must fit within a frame extrusion this places restrictions on the bolt, casing and other component depths and widths that also must observe minimum strength requirements. Futher-more, the lock should comply with Australian Standards for Security Doors, Glass Hinged Doors and Locksets that define strength, durability, corrosion resistance, and ease of use performance requirements.

Locks commonly employed in French doors in Australia do not provide compression, they are lockable only by key and it is not possible to lock the exterior lever while the interior is free to operated to enable egress and in many applications this is inconvenient and in some applications it is unsafe. Locks commonly employed in security doors in Australia do have locking by interior locking lever (snib-lever) but do not provide for locking of the exterior lever while retaining the interior lever free to be operated to enable egress.

The inventions herein, include locks that address the inadequacies of locks commonly employed in French doors and security doors.

The inventions herein, comprise improved complete locks and improvements for locks for displaceable wings that are not just limited to addressing the above described inadequacies of common Security and French Doors.

Summary of the Invention

Driver to operate remote bolts

According to the invention there is a lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

an angularly displaceable driver operably connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

at least one hand operable angularly displaceable lever having a free end and at least one angularly displaceable unlatching cam to operably connect the bolt and driver to the at least one lever,

wherein the bolt is displaceable towards the casing by downward displacement of the free end and each connected drive member is displaceable towards and away from the casing by displacement of the free end.

In forms of the invention, the pivotal axis of the diver intersects through the unlatching cam.

In forms of the invention, wherein the diver comprises a substantially annular member supported within a substantially circular recess.

In forms of the invention, the bolt is rectilinearly displaceable

In forms of the invention, the bolt is angularly displaceable

Exterior handle locking – and adapted locking slide

According to the invention there is a lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt

protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the bolt towards the retracted position including an exterior and an interior hand operable lever operably connected to the bolt by angularly displaceable means,

an adapted locking slide and a hand operable locking member that is operable to displace the said adapted locking slide, said adapted locking slide being displaceable by the locking member to a third locked configuration corresponding to the exterior lever being locked to be restrained against displacement,

said adapted locking slide being displaceable from the third locked configuration to unlock the exterior lever by displacement of the interior lever.

In forms of the invention, wherein the angularly displaceable means comprises an angularly displaceable unlatching rocker.

In forms of the invention, the bolt is rectilinearly displaceable

In forms of the invention, the bolt is angularly displaceable

Exterior handle locking – and adapted dead locking slide

According to the invention there is a lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the bolt towards the retracted position including an exterior and an interior hand operable lever operably connected to the bolt by angularly displaceable means,

an adapted dead locking slide and a hand operable locking member that is operable to displace the said adapted locking slide, said adapted dead locking slide being displaceable by the locking member to a third locked configuration corresponding to the exterior lever being locked to be restrained against displacement,

said adapted dead locking slide being displaceable from the third locked configuration to unlock the exterior lever by displacement of the interior lever.

In forms of the invention, the angularly displaceable means comprises an angularly displaceable unlatching rocker.

In forms of the invention, the bolt is rectilinearly displaceable

In forms of the invention, the bolt is angularly displaceable

Cylinder displaces driver

According to the invention there is a lock including a casing with sides, a bolt supported in the casing to be displaceable between a fully extended position where

the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

an angularly displaceable driver operablely connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

deadlocking means by which to restrain the bolt in the fully extended position including a key operable cylinder and a deadlocking slide that is connected by a deadlocking slide extension to the driver,

said deadlocking slide being displaceable by the cylinder to displace the driver whereby to displace each connected drive member towards and away from the casing.

In forms of the invention, the bolt is rectilinearly displaceable

In forms of the invention, the bolt is angularly displaceable

Automatically locking lock

According to the invention there is a lock including a bolt comprising a latch bolt having an alternative associated auxiliary bolt supported in the casing, said bolt being displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the latch bolt towards the retracted position including an angularly displaceable unlatching rocker operably associated with an exterior and interior hand operable lever,

deadlocking means to restrain the latch bolt in the fully extended position including an alternative locking slide (without an unlatching ramped portion) biased towards the bolt and a cylinder including a key operable barrel that is operably connected to the alternative locking slide,

said alternative locking slide having a horizontally elongated ramped shoulder projecting towards the alternative auxiliary bolt with a horizontal engageable face, said alternative auxiliary bolt also includes a horizontally elongated ramped shoulder projecting towards to deadlocking slide with a horizontal engageable face projecting towards to deadlocking slide,

said alternative auxiliary bolt rearward end being biased and displaceable towards the alternative locking slide; the arrangement being configured such that in a pre-latching configuration, the engageable face of the alternative locking slide is above the engageable face of the alternative auxiliary bolt and the alternative locking slide abuts the bolt to be restrained by the bolt; in the third locked configuration the alternative locking slide lies behind the bolt to deadlock the bolt such that it cannot be

retracted by lever operation and the alternative auxiliary bolt is substantially depressed, at which time

the cylinder can be operated to displace the alternative locking slide to the undisplaced position during which displacement the ramped engageable horizontal face of the slide passes over the ramped engageable horizontal face of the auxiliarly bolt by displacing the auxiliary bolt sideways against spring bias, said auxiliary bolt subsequently ramped engageable horizontal face being displaced towards the alternative locking slide to engage the said slide,

subsequent displacement of the auxiliary bolt as the auxiliary bolt displaces to the fully extended position causes the ramped engageable horizontal face of the bolt to displace from above the ramped engageable horizontal face of the alternative locking slide to thereby release the slide to assume the position corresponding to the pre-latching configuration.

In forms of the invention, the bolt is rectilinearly displaceable

In forms of the invention, the bolt is angularly displaceable

Fixed door lock

According to the invention there is a lock including a casing having a front plate, an angularly displaceable driver operablely connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

at least one hand operable angularly displaceable lever having a free end and at least one angularly displaceable unlatching cam to operably connect the driver to the at least one lever, each connected drive member being displaceable towards and away from the casing by displacement of the free end,

said lock further including a locking plunger that protrudes from the front to be displaceable to engage in a recess in the driver whereby to restrain the driver against displacement.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Definitions and Conventions Employed

This specification and the provisional applications associated with this application, describe inventions comprising improved complete locks for displaceable wings and improvements for locks for displaceable that for convenience are referred to herein as locks.

So throughout this specification and claims which follow, unless the context requires otherwise, the word "locks" or variations such as "lock" will be understood to imply the inclusion of complete locks for displaceable wings and improvements for

locks for displaceable wings that are transportable into other locks and locking devices without being limited to the complete locks described herein.

This specification describes locks substantially as described herein with reference to and as illustrated in the accompanying drawings.

Throughout this specification and claims which follow, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Throughout this specification and claims which follow, unless the context requires otherwise, the positional prepositions such as rear, forward are used to assist in description of the preferred embodiments and with reference to the accompanying drawings and have in general no absolute significance.

Throughout this specification and claims which follow, unless the context requires otherwise, the word "preferably" or variations such as "prefer" does not mean nor infer that that the inventions described in the "Description of the Preferred Embodiments" are restricted to the form of an integer or collection of integers that in some context is described as preferred. Preferably means, that of a number of acceptable alternatives, one is best suited to a particular purpose.

Throughout this specification and claims which follow, unless the context requires otherwise, the words wing embraces both doors and windows.

Throughout this specification, the very lightly printed numerals are to be ignored, being included only to faciliate reference to previous provisional applications.

Throughout this specification and claims which follow, unless the context requires otherwise: **latching** means displacement of an engaging member against biasing means by an engageable means and subsequent displacement of the engaging member into engagement with the engageable means under the action of the **biasing means**, (for hinged doors [within this application] this comprises displacement of a latch bolt or {latch bolt and an auxiliary bolt if there is an auxiliary bolt} towards the lock casing by the strike plate [and in conventional cases, by a curved or angled wing or lip of the strike plate] and subsequent displacement of the latch bolt into the **aperture** of the **strike plate**), (for sliding doors [within this application] this comprises displacement of a latch bolt with hooks or {latch bolt with hooks and an auxiliary bolt} towards the lock casing (as a result of the lock being displaced rectilinearly towards the catch plate) and subsequent displacement of the latch bolt with hooks into the **aperture** of the **catch plate** and displacement of the hooks outwardly to overlap the aperture's peripheral edge whereby to longitudinally

engage the catch plate; within this application a bolt is displaceable between a **fully extended position** in which it is engageable within a strike plate aperture and a **retracted position** where it is removed from the aperture, (said retracted position coinciding with the bolt being substantially within the casing), (said fully extended position embracing a bolt that is substantially fully extended); a **latch-bolt** or **latch bolt** is an outwardly biased bolt capable of executing (or participating in) latching (and includes both rectilinearly displaceable and angularly displaceable bolts) and includes bolts having a leading end that is chamfered or otherwise profiled on one side to facilitate latching [in the context of this application] and a latch bolt also includes a prism shaped bolt that is restrained in a partly extended pre-latching configuration to facilitate latching, said prism shaped bolt in some forms including **counter-acting hooks**, said prism shaped bolts in some forms having a leading end that is chamfered, curved or otherwise profiled on both sides to assist or facilitate latching; an **auxiliary bolt** means an outwardly biased plunger that is operably associated with the latch bolt; **unlatching** means withdrawal of the latch-bolt from engagement with the engageable means, (for hinged door it means withdrawal of the bolt from the aperture of the strike plate); an **unlatching lever** is a lever or knob that is hand operable to cause the latch-bolt to become unlatched; **locking** means configuring the lock to restrain it from being unlatched and in some forms of locks employing deadlocking slides, it includes restraining the deadlocking slide in an operative position to thereby restrain the bolt from being inwardly displaced by the unlatching lever; **deadlocking means** means to configure the lock to restrain the bolt from being displaced from the configuration that it assumes when engaged with the engageable means (in the case of a rectilinearly displaceable bolt for a hinged door, it means restraining the bolt in a fully extended position), the deadlocking means is some forms includes a **deadlocking slide** that is displaceable to cooperate with the bolt to restrain it against displacement; **deadlocked** means the bolt cannot be displaced from the extended position by external forces; **deadlatching** means the bolt is automatically deadlocked during latching; **remote lock** means a locking means disposed from the lock that includes a remote bolt that is operably connected to the lock (often there is an upper and a lower remote lock situated above and below the lock); **French door** means a door comprising a frame with a glass in-fill and often configured in pairs, a second door that is normally closed and is secured by vertical bolts and a first door that has the lock body and operable levers, often they have a strip of compressible sealing material located on the edge against which the first door closes to prevent energy loss, in may forms the door comprises a hollow frame where the hollow within the frame is comparatively small in depth, **security doors** means a

door comprising a hollow framed door with an in-fill of mesh or woven stainless steel where the hollow within the frame is comparatively small in depth and in width; **lock body** is the lock portion fitted within the hollow frame of the wing, the lock body together with a strike plate, a pair of handle sets and a double cylinder comprising a typical mortice lock; **depth of lock body** is the extent of the lock body in a direction parallel to the face of the door; **width of lock body** is the extent of the lock body in a direction at right-angles to the face of the door; **free-rotation-cylinder** is a cylinder comprising a key operable barrel within a **cylinder housing** connected to a **first cam** (in one form having a radially protruding arm) with free movement; **free-rotation-double-cylinder** comprises a cylinder sub-assembly comprised of opposed barrels each connected with free movement to the same first cam such that the cam is free (between limits) to be angularly displaced while the barrels remain undisplaced, this type of cylinder being commonly used in security door locks in Australia to enable the cam to be displaced by either barrel to a locking configuration and then the barrel to be reverse rotated to an undisplaced position enabling key removal while leaving the first cam in the locking position, (this type of cylinder being distinct from the more commonly used double cylinders that employ clutches and that do not have free rotation between the barrels and first cam); **clutched-cam-double-cylinder** comprises a cylinder sub-assembly comprised of opposed barrels each connectable without free movement to the same first cam such that the cam can be angularly displaced by a barrel while the other barrel remain undisplaced, the cylinder includes a clutch to select which barrel is the operative barrel, said clutch being operated by key insertion. In forms of both clutched and free rotation cylinders, the interior key operable is replaced by a hand and operable turn knob.

Description of the Figures

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig 1 is a schematic side view of a lock body with the lid removed and placed beside the lock body, with the bolt fully extended, the unlatching cam at the "undisplaced orientation" and the deadlocking slide is downwardly disposed to enable the cylinder cam arm to enter the deadlocking slide drive recess,

Fig 2 is the lock of Fig 1 but with the deadlocking slide upwardly displaced by the cylinder screw to be in the "undisplaced position",

Fig 3 is the lock of Fig 2, but with the deadlocking slide further upwardly displaced to deadlock the bolt in the "second locked configuration",

Fig 4 is the lock of Fig 3, but with the deadlocking slide further upwardly displaced to deadlock the bolt in the "first locked configuration",

Fig 5 is the lock of Fig 4 from the underside with the side removed,

Fig 6 is the lock of Fig 1 with the deadlocking slide in the "undisplaced position" and the bolt displaced to the retracted position by the unlatching cam

Fig 7 is the lock of Fig 1 with the deadlocking slide in the "undisplaced position" and the bolt in the "pre-latching configuration"

Fig 8 is the lock of Fig 1, with the bolt fully extended, the deadlocking slide in the "undisplaced position" position, each unlatching cam displaced anticlockwise, and the drive slides fully displaced,

Fig 9 is an isometric view of the lock of Fig 9 with Bowden Cable attached

Fig 10 is an exploded view of the lock of Fig 1

Fig 11 is an exploded isometric view from the underside of the lock of Fig10,

Fig 12 is the lock of Fig 3, but adapted to provide exterior lever locking and including an adapted locking slide – the lock being shown in the "third locked configuration",

Fig 13 is the lock of Fig 3, but adapted to provide exterior lever locking and including an adapted deadlocking slide – the lock being shown in the "third locked configuration",

Fig 14 is the lock of Fig 13, with the interior unlatching cam angularly displaced to partly retract the bolt,

Fig 15 is an isometric view showing the lock body and underside of the exterior handle assembly,

Fig 16 is an isometric view of handles and a lock body.

Fig 17 is an underside view of the lock of Fig 18

Fig 18 is the lock of Fig 3, but adapted to provide deadlatching and including an automatic alternative deadlocking slide – the lock being shown with the bolt fully extended and the deadlocking slide in the "second locked" configuration,

Fig 19 shows the lock of Fig 18 unlocked

Fig 20 is the lock of Fig 19, but in the pre-latched configuration,

Fig 21 is an isometric view of a wing with a lock supported adjacent an opening,

Fig 22 is an isometric view of a prism like bolt

Fig 23 is an isometric view of a chamfered bolt

Fig 24 is an isometric view of a retracted prism like bolt with hooking arms

Fig 25 is an isometric view of an extended prism like bolt with hooking arms

Fig 26 is a plan view of the bolt of Fig 25

Fig 27 is an isometric view of an improved strike plate

Fig 28 is a schematic side view of a lock body (with a side removed) having a pivotal bolt with the bolt in the pre-latching configuration,

Fig 29 is a schematic side view of the lock body of Fig 28

Fig 30 is a schematic side view of the lock body of Fig 28 in the first locked configuration,

Fig 31 is a schematic side view of the lock body of Fig 28 being unlocked from the third locked configuration by interior lever operation,

Fig 32 is a schematic side view of the lock with the pivotal bolt fully retracted,

Fig 33 is a partial isometric side/rear view of a pivotal bolt

Fig 34 and 35 are schematic views of the pivotal bolt engaged in the strike plate.

Fig 36 is an isometric view of an improved strike plate for a pivotal bolt

Fig 37 is the lock of Fig 3 but having a pivotal bolt, but adapted to provide deadlatching and including an automatic triggered deadlocking slide – the lock being shown with the bolt fully extended and the deadlocking slide in the "second locked" configuration,

Fig 38 shows the lock of Fig 37 unlocked

Fig 39 is the lock of Fig 37, but in the pre-latched configuration,

Fig 40 is an isometric view showing the horizontal shoulders of Fig 37

Integers from which locks are comprised include, as shown in Fig 1, a **bolt 1, a front plate 2** 5 and a **casing 3** 2 that in some forms comprises **sides 4** 3 attached to each other by internal **fixed portions 5** 4 by **rivets 6** 6A comprising extensions of the fixed portions that have passage through **apertures 7** 6B in the casing sides. The front plate is preferably attached by **screws 8** 6 having passage through **apertures 9** 7 in the front plate to engage in **recesses 10** 8 in the fixed portions, while in other cases a **spacer 11** 9 is between the front plate and sides to provide a lock of increased backset.

In other forms, the front plate, the internal fixed portions and a side comprise a single member such as a single casting to which a separate side is attached.

The bolt comprises a **first portion 12** 11 that is displaceable from the casing through a **bolt aperture 13** 12 in the front plate and a **return portion 14** 13 within the casing by which the bolt is supported. In some forms, the first portion comprises a substantially prism-like solid as shown in Fig 22, (that in some forms is adapted to be slightly angled inwards to assist the bolt enter the aperture in the catch plate or strike plate whereby each side commencing at a position disposed towards the front plate

slopes inwardly towards the leading end – this angling of the sides being different from that described below that addresses inwards displacement of the latch bolt during latching) while in other forms the first portion substantially comprises half a solid prism having a **bevel 220** on one side as shown in Fig 23 that extends from top to bottom and from the **end 15** 14 of the bolt to the portion adjacent the bolt aperture in the front plate of the fully extended bolt, i.e. as is common in bevelled latch bolts. In some forms the latch bolt is rectilinearly displaceable while in other forms the bolt comprises an **angularly displaceable bolt 250** as shown in Fig 28 and 33, that is displaceable about a pivotal axis defined by a **shaft 251** that in some forms comprises a **metal rivet 252** that extends from a side of the casing and in some forms extends between apertures in bolt sides; and the first and return portions are substantially opposed on opposite sides of the pivotal axis.

In other forms again, the first portion comprises a substantially prism-like solid having a slot, in which is supported a pair of counter-acting pivotally displaceable hooking arms that are displaced from the bolt as the bolt displaces to the fully extended position. This form of bolt preferably has a pre-latching configuration to facilitate latching. In some forms of this bolt, there is a vertical slot extending from top to bottom and each hooking arm is displaced from the upper and lower edges of the bolt. In other forms of this lock, the first portion comprises a substantially prism-like solid having a **horizontal slot 16** extending from one side to the other side in which each (of a pair of counter-acting pivotally displaceable) **hooking arms 17** is supported to be displaceable from a side of the bolt as the bolt displaces to the fully extended as shown in Fig 24 to 26. The above-described bolt is suitable for use in locks for both hinged doors when used with a strike plate and sliding doors when used with catch plate. The hooked arms comprise a horizontal **hooking arm 18** terminating at the inner end with a sideways protruding **control shoulder 19** 117 and at the other, outer end, (in a form of the arm) in a **hook 20** 118 that is displaceable from within the bolt to protrude from the side of the bolt, to engage behind the **aperture edge 21** within a **catch plate 22** or **strike plate 23** as shown in Fig 26 whereby to become longitudinally engaged. The arms are supported by a vertical **pin 24** 19 that has passage through an aperture in each arm, said pin defining the vertical pivotal axis of each arm.

The hooked arm is configured such that as the bolt displaces towards the fully extended position, each control shoulder is brought into contact with the **inside face 25** 121 of the front plate 2 and as the bolt further extends, the arm is forced inwardly by the front plate aperture 13 to displace the hook 20 outwardly – the **front plate aperture edge 26** exerting a moment on each arm to displace it.

When the bolt is displaced towards the retracted position from the fully extended and engaged configuration, the strike plate or catch plate aperture edge 21 acts on the hooks (or ramped surface) to displace the hooks into the bolt envelope where they are retained by the front plate aperture edge 26 – the hooked arm being so restrained when the bolt is in the pre-latching configuration and until the hooks have entered the strike plate or catch plate aperture during latching. In other forms, each hook is replaced by a **ramped shoulder 27** 122.

The width **w1 28**, of the bolt first portion is preferably of reduced width to be less than the width of the bolt return portion **w2 29** so that the bolt with outwardly displaced control shoulders as shown *in Fig 23* can displace within the sides of the casing, i.e. within a width of (w2 plus working clearances)

In some locks, the **corners 30** of the upper and lower edges of the bolt aperture are radiused to provide increased front plate strength and the upper and lower **edges 31** of the bolt are configured to conform to the aperture profile with working clearances

The bolt (having a first portion substantially comprising a prism-like solid) in some forms comprises an outwardly biased latch bolt, that in some forms has the leading end 15 profiled on both sides to facilitate latching wherein the leading portion is chamfered and/or curved, or otherwise profiled on each side to assist latching wherein the latch bolt is engageable on either side by a strike plate 23 to be inwardly displaced by the strike plate during latching, said profiling in some forms comprising a simple radius on the edge defining the junction between the side of the bolt and the outer end of the bolt, said profiling accommodating both left hand and right hand doors. Where the bolt comprises a pivotal bolt, the **leading portion 253** in some forms is chamfered and/or curved, or otherwise profiled on each side as shown in Fig 33 to 35 to assist latching wherein the latch bolt is engageable on either side by a strike plate 23 to be inwardly displaced by the strike plate during latching.

Where the bolt having a first portion substantially comprising a prism-like solid that in the fully extended position extends so far as to not be able to engage with the strike plate to be inwardly displaced by the strike plate to effect latching, the lock includes means to restrain the bolt in a partly extended pre-latching configuration from which it is able to engage with the strike plate to be inwardly displaced to effect latching. In forms of locks where the fully extended bolt extends beyond the **wing or curved lip 32** of a conventional strike plate, the bolt preferably has the partly extended pre-latching configuration. Where the bolt comprises a pivotal bolt, the bolt preferably has the partly extended pre-latching configuration shown in Fig 28 and Fig 29 to facilitate latching.

Some locks (and even those having a bolt with a chamfered side for latching) have a partly extended pre-latching configuration to improve latching even though this it is not essential for latching.

In one form the (means to provide pre-latching) includes an outwardly biased **auxiliary bolt 33** as shown in Fig 1 comprising a **first auxiliary bolt portion 34** 18 that protrudes from the front plate and that is displaceable into the casing through an auxiliary **bolt aperture 35** 19 in the front plate and a **return auxiliary bolt portion 36** 20 within the casing by which it is supported. The auxiliary bolt is (including locks having a pivotal bolt), preferably outwardly biased by a **torsion spring 145** supported about a sideways protruding **pin 146** being an extension of a casing fixed portion and the spring has a **spring arm 147** that lies behind the sideways protruding pin of the auxiliary bolt. In other forms of locks, the auxiliary bolt is outwardly biased by the compression **spring 37** 17 that acts between the outer **end 38** of a **spring recess 39** in the auxiliary bolt and a **vertical wall 40** of a casing fixed portion.

The first auxiliary bolt portion in some forms comprises a prism-like member as shown in Fig 16 having a **leading end 41** 21 profiled on both sides to accommodate both left hand and right hand doors wherein the profiled portion on each side is curved, chamfer or otherwise profiled to facilitate latching wherein the auxiliary bolt is engageable on either side by a strike plate to be inwardly displaced by the strike plate during latching.

The return portion 36 20, as shown in Fig 7, has a sideways protruding shoulder preferably comprising a cylindrical **pin 42** 23 that engages within an aperture of an adjacent **control slide 43** 24 that is located within the casing adjacent a sidewall to be vertically rectilinearly displaceable. The control slide aperture includes an upwardly **ramped slot 44** having a lower **ramped edge 50** 25 that lies in the same vertical plane as the pin 42 23. The parts are configured such that as the auxiliary bolt is inwardly displaced the pin 42 23 slides along the ramped shoulder 50 ~~45~~25 to urge the control slide away from the bolt to displace a **control shoulder 46** of the control slide away from the bolt to enable it to be displaced to the fully extended position by biasing means derived from **spring 47** 27 as will be explained in more detail below. The control slide at the leading end has the control shoulder 46 that is engageable in a **edge recess 48** 28 in the under-edge of the bolt that comprises a horizontally elongated slot extending from a substantially **vertical slot end 49** towards the outer end of the bolt – preferably the slot does not extend sideways to the surface of the bolt.

The ramped slot is also defined in-part by a upper **ramped edge 45** 25B that lies in the same vertical plane as the pin 42 23. The parts are configured such that as

the auxiliary bolt is outwardly displaced the pin 42 23 slides along the upper ramped shoulder 45 ~~50 25B~~ to urge the control slide towards the bolt to displace the control shoulder of the control slide towards engagement with the bolt. In some forms of locks the aperture in the control slide includes a substantially **horizontal elongation 51** to accommodate additional displacement of the auxiliary bolt.

It should be noted that when the front plate is removed one control slide can be substituted for another whereby to change the distance the auxiliary bolt and latch bolt protrude front the front plate in the pre-latching configuration.

In normal usage, the bolt is fully retracted by unlatching lever operation and the wing is opened whereby to enable the auxiliary bolt to outwardly displace till it is restrained by the control slide itself restrained by abutting the bolt. As the unlatching lever is then reversed towards the undisplaced position, the bolt outwardly displaces during which displacement the control shoulder is displaced by the auxiliary bolt into the under-edge recess to restrain the bolt in the pre-latching configuration.

Where the bolt comprises a pivotal bolt, the lock includes an outwardly biased **auxiliary bolt 254** similar to 33 as shown in Fig 28 comprising a **first auxiliary bolt portion 255** that protrudes from the front plate and that is displaceable into the casing through an auxiliary bolt aperture in the front plate and a **return auxiliary bolt portion 256** similar to 36 within the casing by which it is supported.

The first auxiliary bolt portion in some forms comprises a prism-like member having a **leading end 255** profiled on both sides as shown in Fig 16 to accommodate both left hand and right hand doors wherein the profiled portion on each side is curved, chamfer or otherwise profiled to facilitate latching wherein the auxiliary bolt is engageable on either side by a strike plate to be inwardly displaced by the strike plate during latching.

The return portion 256, as shown in Fig 29, has a sideways protruding shoulder preferably comprising a cylindrical **pin 257** that engages within an aperture of an adjacent **control slide 258** that is similar to 43 that is located within the casing adjacent the other sidewall to be vertically rectilinearly displaceable. The control slide aperture includes an upwardly **ramped slot 259** having a lower **ramped edge 261** that lies in the same vertical plane as the pin. The parts are configured such that as the auxiliary bolt is inwardly displaced the pin slides along the ramped shoulder 261 to urge the control slide away from the bolt to displace a **control shoulder 262** similar to 46 of the control slide away from the bolt to enable it to be displaced to the fully extended position by biasing means derived from **spring 263** as will be explained in more detail below. The control slide at the leading end has the control

shoulder 262 that is engageable in an **edge recess 264** in the return portion of the bolt that includes a substantially **vertical slot shoulder 265.**

The ramped slot is also defined in-part by an upper **ramped edge 260** that lies in the same vertical plane as the pin. The parts are configured such that as the auxiliary bolt is outwardly displaced the pin slides along the upper ramped shoulder 260 to urge the control slide towards the bolt to displace the control shoulder of the control slide towards engagement with the bolt. In some forms of locks the aperture in the control slide includes a substantially **horizontal elongation 266** to accommodate additional displacement of the auxiliary bolt.

It should be noted that when the front plate is removed one control slide can be substituted for another whereby to change the distance the auxiliary bolt and latch bolt protrude front the front plate in the pre-latching configuration.

In normal usage, the bolt is fully retracted by unlatching lever operation and the wing is opened whereby to enable the auxiliary bolt to outwardly displace till it is restrained by the control slide itself restrained by abutting the bolt. As the unlatching lever is then reversed towards the undisplaced position, the bolt outwardly displaces during which displacement the control shoulder is displaced by the auxiliary bolt into the under-edge recess to restrain the bolt in the pre-latching configuration.

Integers include an **unlatching rocker** 52 30 as shown in Fig 1, that is angularly displaceable about a **pivotal axis 53** 32 orthogonal to the sides of the casing and that is supported by a **shaft 54** that is some forms comprises a pinned extension of the casing and in other forms comprises a **rivet 55** 31 that passes from one side of the casing to the other to both support the rocker and fasten the sides of the casing, said unlatching rocker having a **first arm 56** 33 extending upwardly from the pivotal axis to terminate in a engageable **shoulder 57** 34 while the **second arm 58** 35 extends downwardly to overlap the return bolt portion so that the bolt is inwardly displaceable by anti-clockwise angular displacement of the unlatching rocker. In forms of the invention, the overlapping second arm portion includes a sideways protruding **drive pin 58** 36 as shown in Fig 11, that locates in a **drive recess 59** 37 in a side of the bolt as shown in Fig 10.

Integers include means to outwardly bias the latch bolt comprising a spring that in a form of the invention comprises a compression **spring 60** 27 as shown in Fig 10 that acts directly on second arm of the rocker to outwardly bias the bolt by outwardly biasing the second rocker arm, while in other forms of locks the spring acts directly on the bolt.

In the case of a lock that has a pivotal bolt, integers include an **unlatching rocker 267** similar to 52 as shown in Fig 28, that is angularly displaceable about the

pivotal axis 53 orthogonal to the sides of the casing and that is supported by a **shaft 54** that is some forms comprises a pinned extension of the casing and in other forms comprises a **rivet 55** that passes from one side of the casing to the other to both support the rocker and fasten the sides of the casing, said unlatching rocker having a **first arm 268** similar to 56 extending upwardly from the pivotal axis to terminate in a engageable **shoulder 269** similar to 57 while the **second arm 270** similar to 58 extends downwardly to overlap the return bolt portion so that the bolt is inwardly displaceable by anti-clockwise angular displacement of the unlatching rocker. In forms of the invention, the overlapping second arm portion includes a sideways protruding **drive pin 271** similar to 58 as shown in Fig 28, that locates in a **drive recess 272** in a side of the bolt.

Integers include means to outwardly bias the latch bolt comprising a spring that in a form of the invention comprises a compression **spring 60** 27 that acts directly on second arm of the rocker to outwardly bias the bolt by outwardly biasing the second rocker arm, while in other forms of locks (and those that do not provide deadlatching) the spring acts directly on the bolt. Where the bolt is pivotal, in some forms the spring comprises a similar spring 263 that acts on the unlatching rocker.

The rear end of the spring in forms of the invention is seated in a circular **spring recess 61** in the casing rear wall and coaxial with this recess and the spring is a an **elliptical aperture 62** as shown in Fig 11 (defined by the general equation $x^2/a^2 + y^2/b^2 = c^2$ where the major diameter is substantially the same as the outer diameter of the spring and substantially the same as the diameter of the spring recess, said elliptical recess having passage through the rear of the casing to enable the spring to be loaded into the casing after the lock body has (otherwise) been assembled by twisting the spring so that it takes a form having an elliptical cross-section that can be inserted through the elliptical aperture whereby to resume its normal shape once within the casing, whereupon the rear end of the spring deforms to become seated within the spring recess

Integers include operating means by which to displace the bolt towards the retracted position including at least one **unlatching cam 62** 39 **as shown in Fig 1** connected to an interior **hand operable lever 63** as shown in Fig 16. In some forms of the invention, the unlatching cam and lever are connected by a shaft that extends between the lever (said lever being part of a **handle assembly 64** 44 mounted to the face of the wing) and a mating **drive aperture 65** 43 in the unlatching cam. The unlatching cam as shown in Fig 1 has a downwardly extending **unlatching arm 66** 45 that has towards the free end a **driving shoulder 67** 46 that is rearward of the rocker first arm and within the same plane such that downwards lever operation

displaces the driving shoulder clockwise to displace the drive rocker in an anti-clockwise direction to cause the bolt to retract. The unlatching cam is preferably supported by at least one sideways protruding **cylindrical portions 68** 47 as shown in Fig 10 and 11 that extends into a **circular aperture 69** 47A in a side of the casing and the cylindrical portion also preferably includes the shaft **drive aperture 65** 43 to receive and mate with the shaft.

In some forms of the invention the unlatching cam and lever are connected by a shaft that extends between an **exterior lever 70** 41 and an **interior lever 71** 42 as shown in Fig16, while having passage through the mating drive aperture in the unlatching cam or mating drive recesses in a pair of unlatching cams if the lock has a lockable exterior lever.

In some forms of locks, the exterior lever can be independently locked from the interior by a **locking member 73** (that may comprise a locking lever) described below and these locks can be simultaneously unlocked and unlatched by operation of the interior lever. This functionality requires the lock to include an **exterior lever** connected to an **outer unlatching cam 74** 48 by an **exterior shaft 75** 49 and an **interior lever 76** connected to an **inner unlatching cam 77** 50 by an **interior shaft 78** 51 (each said shaft mating without free movement with its respective associated unlatching cam and lever) each said unlatching cam preferably being supported adjacently each other and each having both an unlatching arm as described above and a drive arm as described below – and each is independently operable to retract the latch bolt.

Integers include an interior hand operable locking member 73 as shown in Fig 16, that is operably connected to a **deadlocking slide 79** as described below and shown in Fig 1 whereby to be operable to actuate the deadlocking slide to and from a second locked configuration, said locking member in one form comprising an angularly displaceable **locking lever 83** (also called a **snib-lever**) that is connected by a **spindle 84** 53 to an angularly displaceable **locking cam 85** 54 having a **spindle aperture 86** 55 and a **locking arm 87** 56, said locking arm having a displaceable **free end 88** that is engaged (with free movement) within a **recess 89** in a side of the deadlocking slide. In forms, the locking cam 85 is supported by **cylindrical portions 90** 54A that are within **circular apertures 91** 54B in the sides of the casing, and in other forms the locking arm has a sideways protruding pin that engages in a horizontal slot in the deadlocking slide. The locking lever is configured such that it cannot be displaced to displace the deadlocking slide further than a second locked configuration or third locked configuration described below – the

rotation of the locking cam being limited by engagement between **portion 92** and a rear portion of the casing.

Integers further include the deadlocking slide 79 to restrain the bolt from being displaced to the retracted position. In some forms of the deadlocking slide as shown in Fig 3, has a **leading end 93** 58 that is co -operable with the fully extended bolt to restrain the bolt from being displaced from the fully extended position. In some forms, the deadlocking slide has an **engaging shoulder 94** 58A that is engageable behind an **engageable shoulder 95** 59 of the bolt as shown in Fig 2 (and that lies in the same vertical plane (a plane parallel a casing side) as the engageable shoulder 95 of the bolt) – the configuration in which the bolt and slide cooperate being referred to herein as the deadlocking configuration and when so engaged the deadlocking slide can be said to be in a deadlocking position [this deadlocking position actually comprises a limited range of deadlocking slide positions over which the bolt and slide so cooperate]. The engageable shoulder preferably comprises a vertical shoulder defined in-part by a change in the width of the bolt at the junction between the first and return portions of the bolt – the first portion being of greater width that the return portion.

Where the bolt is pivotal, the deadlocking slide **leading end 273** as shown in Fig 30 is co -operable with the fully extended bolt to restrain the bolt from being angulaly displaced to retract the bolt from the fully extended position. In some forms, the leading end has a sideways protruding **engaging shoulder 274** that is engageable behind an **engageable shoulder 275** of the bolt (and that lies in the same vertical plane (a plane parallel a casing side) as the engageable shoulder 275 of the bolt) – the configuration in which the bolt and slide cooperate being referred to herein as the deadlocking configuration and when so engaged the deadlocking slide can be said to be in a deadlocking position [this deadlocking position actually comprises a limited range of deadlocking slide positions over which the bolt and slide so cooperate]. The engageable shoulder preferably comprises a vertical shoulder that in one form is defined in-part by a change in the width of the bolt, while in another form it comprises a vertical slotted recesses in the bolt (vertical when the bolt is fully extended.

The deadlocking slide leading end in some forms comprises an inwardly ramped portion engageable with the lower corner of the engageable shoulder such that displacement of the deadlocking slide towards the bolt causes the ramp to slide over the corner to cause the bolt to be outwardly displaced (if the bolt is not fully extended when the deadlocking slide is displaced towards the bolt).

Integers further includes an angularly displaceable **first cam 96** 61 as shown in Fig 1 and 4 , (having a radially protruding **cam arm 97** 62) that in some forms of locks is supported within the casing by the sides of the casing as occurs in the lock of [Watts AU 696343] to be operable by a barrel supported within each handle portion, per [Watts AU 696343] herein being included by reference, and in other forms, the first cam is connected to a hand operable member that in some forms comprises an operable knob. The first cam in some forms of locks is as described in [Watts AU706589] which is included herein by reference, said first cam in some forms of locks comprising part of a sub-assembly comprising a **free-rotation-cylinder 98** 63 as shown in Fig 16, defined above and that is assembled to the lock body as a whole and wherein the first cam is supported within the casing adjacent the deadlocking slide as shown in the figures. The first cam of the free-rotation-cylinder in some forms is connected to a key operable single cylinder on each side but in other forms it is connected to a hand operable member on one side that in some forms comprises an operable knob.

The first cam is operably connected to the deadlocking slide by a **drive recess 99** 64 having an **upper drive face 100** 65 on which the first cam arm acts to drive the deadlocking slide towards the deadlocking configuration and having a **lower drive face 101** 66 on which the first cam arm acts to drive the deadlocking slide from the deadlocking configuration and an **exit shoulder 102** 67 (in some forms comprising an angled face) connected to the upper drive face disposed such that when in the deadlocking slide is in the first locking configuration, the first cam **end face 103** 68 (a face of constant radius) is adjacent the exit shoulder such that the force that is applied to the first cam by the deadlocking slide when an attempt is made to move the deadlocking slide from the deadlocking configuration (as might occur in an attempt to rotate the snib lever) has a direction that passes through the **pivotal axis 104** 69 of the cam and so the cam cannot be rotated and the first cam in this configuration restrains the deadlocking slide.

In some forms of locks, there are two locking modes: **a second locked mode** shown in Fig 3 into which and from which the lock can be displaced by actuation of an interior locking lever and by actuation of the first cam, and a **first locked mode** shown in Fig 4 into which the lock can be displaced by actuation of the first cam and from which it can be displaced by only the first cam. In some forms of locks there is an exterior locking lever, as described in [Watts AU 18474/2000] that hereby included by reference, that is operable to displace the lock into the second locked mode but which is not operable to displace the lock from the second locked mode.

In forms of locks, the **second locked mode,** as shown in Fig 3 is characterized by the first cam arm being within the drive recess and the deadlocking slide having been displaced into the deadlocking configuration by the locking lever or by the first cam, and the **first locked mode** as shown in Fig 4,characterized by the deadlocking slide being displaced into the deadlocking configuration and the first cam arm being displaced from within the drive recess to restrain the deadlocking slide in the deadlocking configuration from which the deadlocking slide cannot be displaced by the locking lever.

In some forms of the invention, the deadlocking slide supports a spring loaded **ball 105** 70 as shown in Fig 1 that is engageable in **recesses 106** 71**,107** 72**, 108** 73 in a side of the casing corresponding to an undisplaced deadlocking slide, a deadlocking slide in the second locking configuration and a deadlocking slide in the first locking configuration and in deadlatching forms, the recess 106 and 107 are connected by a vertically elongated slot to comprise **recess 109** 74 *of Fig 16*

Where the cylinder comprises a double free-rotation-cylinder a **cylinder screw 110** is employed to restrain the lock cylinder within the lock body, said screw having passage through a **screw aperture 111** in some front plates and being engageable in a **threaded aperture 112** in the lock cylinder, and in these forms the screw also performs the function of restraining the first cam within the drive recess by restricting the downward displacement of the deadlocking slide from the undisplaced position. In usage, after the cylinder has been inserted in the cylinder aperture in the lock body, the first cam is rotated to be within the drive recess at which time the cylinder screw is inserted to displace the deadlocking slide away from the initial position and to the undisplaced position (corresponding to the ball being in aperture 106) that does not allow the first cam to be displace downwardly to leave the drive recess.

In forms where the cylinder comprises a fixed cam cylinder, the first cam is operated by being rotated 360 degrees and in locks employing such cylinders, the lock does not include the locking lever, locking cam (and exterior locking lever) and the first cam is given space to fully rotate. In this case during locking, the first cam leaves the drive recess, passes over the exit face and comes to rest in the initial undisplaced position enabling key removal. In this case, the spring-loaded ball is engageable in recesses corresponding to an undisplaced slide and a slide in the first locked configuration.

In some forms of locks as shown in Fig 12 to 14 and Fig 28 to 32, the exterior lever can be independently locked from the interior by the interior locking-lever and simultaneously unlocked and unlatched by operation of the interior lever. As with

many of the improvements described herein that are transportable into other locks, this functionality can readily be transported into security door locks that include a deadlocking slide and a locking snib such as described in [Watts AU706589] and [Lockwood 12029/88].

Some forms of locks, include a lockable **exterior lever** as shown in Fig 15 connected to an **outer unlatching cam** by an exterior shaft and an **interior lever** connected to an **inner unlatching cam** by an **interior shaft** as described above - each said unlatching cam having both an unlatching arm and a drive arm and each being independently operable to displace the unlatching rocker to retract the latch bolt and each being independently operable to actuate the driver annulus described below.

In these forms of locks the spindle of the locking lever has passage through the lock body to mate within a **lever locking cam 113** 76 supported on the underside of the **exterior lever backplate 114** 77 and the deadlocking slide described above is adapted to comprise either an adapted locking slide or an adapted deadlocking slide as described below.

The **adapted locking slide 115** 79 includes a ramped **unlocking shoulder 116** 78 that in the **third locked configuration** (a configuration otherwise corresponding to the second locked configuration described above) is rearwardly disposed of the latch bolt and that is engageable by an inwardly displacing bolt to cause the deadlocking slide to downwardly displace to cause the locking cam to be rotated in an anticlockwise direction to actuate the lever locking cam in an unlocking direction.

In some forms of locks where the bolt is deadlocked by the deadlocking slide when the lock is in the third locked configuration as shown in Fig 13, the deadlocking slide comprises an **adapted deadlocking slide 117A** that includes a **deadlocking shoulder 118** 80 that lies in the same vertical plane (a plane parallel a casing side) as the engageable shoulder of the bolt, and adjacent to a ramped **unlocking shoulder 116** that lies in the same plane (a plane parallel a casing side) as the unlatching rocker, such that in the **third locked configuration** both shoulders are rearwardly disposed of the bolt, the deadlocking shoulder to restrain the bolt from being inwardly displaced and the unlatching rocker to be displaced by the unlatching rocker whereby to retract the bolt. The unlocking shoulder is engageable by a **nose portion 117** 81 of the second arm of the unlatching rocker as it rearwardly displaces to retract the latch bolt. The unlatching rocker is outwardly biased by a **spring 119** 27 supported within a **spring recess 120** 27A in the casing and that acts directly on a protruding **pin 121** 82 of the rocker second arm as shown in Fig 11, to outwardly bias

the rocker and the drive pin of the rocker acts within the bolt drive recess to outwardly bias the bolt - the bolt recess being enlarged to provide the rocker sufficient free movement to displace reawardly (while the bolt remains undisplaced) to enable the nose portion to displace the unlocking shoulder whereby to displace the deadlocking shoulder from behind the engageable shoulder to enable the bolt to inwardly displace.

The second arm, deadlocking slide and bolt are preferably configured such that displacement of the bolt to a partly retracted position corresponds to the deadlocking slide having been displaced to the undisplaced position. The lock is preferably further configured such that the undisplaced position of the deadlocking slide corresponds to an undisplaced locking cam and to an undisplaced locking lever and an undisplaced lever locking cam and an unlocked exterior lever.

In some forms of locks that have a pivotal bolt and where the bolt is deadlocked by the deadlocking slide when the lock is in the third locked configuration the deadlocking slide comprises a **different deadlocking slide 276** similar to 117 that includes the deadlocking shoulder 274 that lies in the same vertical plane (a plane parallel a casing side) as the engageable shoulder 275 of the bolt, and adjacent to a ramped **unlocking shoulder 277** similar to 116 that lies in the same plane (a plane parallel a casing side) as the unlatching rocker, such that in the **third locked configuration** both shoulders are rearwardly disposed of the bolt, the deadlocking shoulder to restrain the bolt from being inwardly displaced and the unlatching shoulder to be displaced by the unlatching rocker whereby to displace the deadlocking slide to enable the bolt to be retracted – being seen in Fig 31 unlocked and about to displace the bolt. The unlocking shoulder is engageable by a **nose portion 278** similar to 117 of the second arm of the unlatching rocker as it rearwardly displaces to retract the latch bolt. The unlatching rocker is outwardly biased by a **spring 279** similar to 119 supported within a **spring recess 280 similar to 120** in the casing and that acts directly on a protruding **pin 281** similar to 121 of the rocker second arm to outwardly bias the rocker and the drive pin of the rocker acts within the bolt drive recess to outwardly bias the bolt - the bolt recess being enlarged to provide the rocker sufficient free movement to displace reawardly (while the bolt remains undisplaced) to enable the nose portion to displace the unlocking shoulder whereby to displace the deadlocking shoulder from behind the engageable shoulder to enable the bolt to inwardly displace.

The second arm, deadlocking slide and bolt are preferably configured such that displacement of the bolt to a partly retracted position corresponds to the deadlocking slide having been displaced to the undisplaced position. The lock is

preferably further configured such that the undisplaced position of the deadlocking slide corresponds to an undisplaced locking cam and to an undisplaced locking lever and an undisplaced lever locking cam and an unlocked exterior lever.

The lever locking cam supported coaxially with the spindle on the underside of the exterior lever backplate, has an **arm 122** 84 by which the cam and spindle and locking cam are operably connected to a **stop blade 123** 83 that is upwardly displaceable by spindle rotation to engage in a **stop slot 124** 85 of a **stop washer 125** 86 attached coaxially to the shaft portion of the exterior lever. The components are configured such that when the locking lever and spindle are undisplaced, the exterior lever is unrestrained but if the deadlocking slide is in the third locked configuration, the stop blade is within the stop recess restraining the exterior lever against displacement. In usage, when the interior lever is pushed down to retract the bolt, the deadlocking slide is displaced to angularly displace the locking cam to angularly displace the spindle to unlock the exterior lever. As will be appreciated, the exterior lever can also be unlocked by the cylinder from either side and by the locking lever.

The stop blade preferably comprises a part of a rectilinearly displaceable **stop slide 126** 83A supported between the **side walls 127** of the exterior back plate and biased by compression **spring 128** 83B away from the stop washer – said spring being supported within a vertically elongated spring **slot 129** of the stop slide to act downwardly on the **lower end 130** of the spring slot while acting upwardly on a **screw 131** that intersects the spring slot to retain the slide adjacent the back plate.

There are preferably a pair of horizontally opposed arms disposed on opposite sides of the **spindle pivotal axis 132**, each arm terminating in an engaging profiled **shoulder 133** 76B and the **horizontal lower edge 134** of the stop slide includes a pair of **recesses 135** 83C one recess engageable by a shoulder 133 and the other recess engageable by the other shoulder 133. When the stop slide is undisplaced, each shoulder abuts the horizontal lower edge of the stop slide and when the lever locking cam is in a displaced position corresponding to the third locked configuration, one of the shoulders 133 is within a recess 135. The recesses and shoulders are configured such that the stop slide biased by spring cannot dislodge a shoulder from its recess (this being possible by spindle rotation alone) because the vector defining the normal to the surface of the recess at the point of contact by the shoulder is configured to pass through the pivotal axis of the lever locking cam.

It will be appreciated that this arrangement also biases the locking lever towards an undisplaced position.

In some forms of locks (that have a pre-latching configuration), the locks have a **deadlatching bolt 136** that automatically deadlocks each time it extends to the fully extended position. In these forms of the invention the locking cam and locking member may be omitted and the deadlocking slide comprises an **alternative deadlocking slide 137** similar to the deadlocking slide but biased by compression **spring 138** as shown in Fig 17 towards the second locked configuration, and the ball is provided with the vertically elongated recess (described above) in which to unrestrainedly displace and the alternative deadlocking slide includes a vertically elongated **spring recess 139** to house the spring. The alternative deadlocking locking slide has a horizontally elongated **ramped shoulder 140** projecting towards the alternative auxiliary bolt that includes a horizontal **engageable face 141.**

The alternative auxiliary bolt is similar to the auxiliary bolt but has a rearwardly projecting **blade portion 142** that passes beside the alternative deadlocking slide and that has a horizontally elongated **ramped shoulder 143** projecting towards the deadlocking slide with a horizontal **engageable face 144** projecting towards the alternative deadlocking slide. The alternative auxiliary bolt is outwardly biased by the **torsion spring 145** supported about the sideways protruding **pin 146** being an extension of a casing fixed portion - this means of biasing the auxiliary bolt can also be applied to all the locks described above. The spring has a **spring arm 147** that lies behind the sideways protruding pin of the alternative auxiliary bolt. The blade is biased and displaceable towards the alternative locking slide as a result of the auxiliary bolt being restrained against outward displacement by contact with the strike plate while a side of the alternative auxiliary bolt is urged by the spring arm 147 – this arrangement giving rise to a moment that causes the auxiliary bolt to be urged towards the alternative deadlocking slide – because the spring arm is on the opposite side of the auxiliary bolt from the blade portion 355

The lock is configured such that in the pre-latching configuration, the engageable face of the alternative locking slide is above the engageable face of the alternative auxiliary bolt and the alternative locking slide abuts the bolt to be restrained by the bolt. When the wing is closed the bolt is displaced to the fully extended position and the alternative deadlocking slide is displaced to the second locking configuration while the alternative auxiliary bolt is retained depressed. In this locked configuration the alternative locking slide lies behind the bolt to deadlock the bolt such that it cannot be retracted by lever operation and the alternative auxiliary bolt is depressed.

When in the second locked configuration, either the (cylinder - if included) or (locking lever - if included) can be operated to displace the alternative deadlocking slide to the undisplaced position during which displacement the ramped engageable horizontal face of the deadlocking slide passes over the ramped engageable horizontal face of the alternative auxiliary bolt by displacing the blade of the alternative auxiliary bolt sideways, after which the blade portion of the auxiliary bolt displaces towards the alternative locking slide to engage the said slide and retain it until such time as the alternative auxiliary bolt is depressed. When the auxiliary bolt displaces to the fully extended position as occurs when the wing is opened, the ramped engageable horizontal face of the auxiliary bolt displaces outwardly from above the ramped engageable horizontal face of the alternative locking slide to thereby release the slide to assume the position corresponding to the pre-latching configuration where the alternative deadlocking slide abuts the bolt.

In some forms of locks as shown in Fig 37 to 40 (that have a pre-latching configuration), the locks have a pivotal **deadlatching bolt 350** that automatically deadlocks each time it extends to the fully extended position. In these forms of the invention the locking cam and locking member may be omitted and the deadlocking slide comprises a **triggered deadlocking slide 351** similar to 137 biased by compression **spring 352** similar to 138 towards the second locked configuration, and the ball is provided with the vertically elongated recess (described above) in which to unrestrainedly displace and the triggered deadlocking slide includes a vertically elongated **spring recess 352** to house the spring. The triggered deadlocking locking slide has a horizontally elongated **ramped shoulder 353** projecting towards the alternative auxiliary bolt that includes a horizontal **engageable face 354.**

The **triggering auxiliary bolt 355** is similar to the auxiliary bolt but has a rearwardly projecting **blade portion 356** that passes beside the triggered deadlocking slide and that has a horizontally elongated **ramped shoulder 357** projecting towards the deadlocking slide with a horizontal **engageable face 358** projecting towards the alternative deadlocking slide.

The triggering auxiliary bolt is outwardly biased by a **torsion spring 359** similar to 145 and supported about a sideways protruding **pin 360** similar to 146 being an extension of a casing fixed portion. The spring has a **spring arm 361** similar to 147 that lies behind the sideways protruding pin of the alternative auxiliary bolt. The blade is biased and displaceable towards the triggered deadlocking slide as a result of the auxiliary bolt being restrained against outward displacement by contact with the strike plate while a side of the alternative auxiliary bolt is urged by the spring arm 361 – this arrangement giving rise to a moment that causes the auxiliary bolt to

be urged towards the alternative deadlocking slide – because the spring arm is on the opposite side of the auxiliary bolt from the blade portion 355

The lock is configured such that in the pre-latching configuration shown in Fig 39, the engageable face 354 of the alternative locking slide is above the engageable face 358 of the alternative auxiliary bolt and an **end shoulder 351A** of the alternative deadlocking slide abuts a **circular shoulder portion 350A** bolt to be restrained by the bolt. When the wing is closed the bolt is displaced to the retracted and then the fully extended position shown in Fig 37 to cause 351A to be displaced from 350A to enable the triggered deadlocking slide to be displaced to the second locking configuration where the shoulder 351A and shoulder 273 enter the **recess 350B** in the return portion of the bolt forward of bolt shoulder 275 - while the triggering auxiliary bolt is retained depressed. In this locked configuration the triggered deadlocking slide lies adjacent to shoulder 275 restraining the bolt from being angularly displaced.

When in the second locked configuration, either the (cylinder - if included) or (locking lever - if included) can be operated to displace the triggered deadlocking slide to the undisplaced position during which displacement the ramped engageable horizontal face of the deadlocking slide 353 passes over the ramped engageable horizontal face of the triggering auxiliary bolt 358 by displacing the blade of the auxiliary bolt sideways, after which the blade portion of the triggering auxiliary bolt displaces towards the triggered locking slide to engage the said slide and retain it as shown in Fig 38 and until such time as the alternative auxiliary bolt is depressed. When the triggering auxiliary bolt displaces to the fully extended position as occurs when the wing is opened, the ramped engageable horizontal face of the auxiliary bolt displaces outwardly from above the ramped engageable horizontal face of the alternative locking slide to thereby release the triggered locking slide to assume the position corresponding to the pre-latching configuration where the triggered deadlocking slide abuts the bolt.

Integers further includes drive means to operate an upper and/or a lower remote engaging member, said drive means including one and in forms of the invention, a pair of counteracting drive slides operably connected to an angularly displaceable **driver 149** 90 as shown in all the figures that in one form comprises a **driver annulus 150** 91 having a **base 151** as shown in Fig 2 supported within the casing and in some forms of the invention supported within a raised **annular wall 152** 92 that completely or partly surrounds the drive annulus, said annular wall being supported by or comprising part of the casing.

In a form of the invention, the driver member at a position disposed from its pivotal axis is connected to an **upper drive slide 153** 94 by a **first joint 154** 95 as *shown in Fig* , and in some forms the drive member is operably connected at a position disposed from its pivotal axis to a **lower drive slide 155** by a **second joint 156** 96 and in some cases the driver is connected to both upper and lower drive slides. The joints as shown in Fig 2 provide relative angular displacement between the driver and the upper drive slide and in one form comprise a **pin-joint 157** comprising a **pin 158** extending sideways from within apertures in the slide and driver member and having angular free movement relative to at least one. In some forms, the first and second joints are an equidistance (a radius **r**) from the **driver pivotal axis 159** and on opposite sides of the pivotal axis and in some forms, the joints and pivotal axis are in the same horizontal plane when the driver is angularly disposed half way between the undisplaced and fully displaced positions. In forms of the invention shown in the figures, the first joint is rearwardly disposed of the pivotal axis and the second joint is forwardly disposed and the joints are on opposite sides of the driver member as shown.

In other forms, the joint comprises a sideways protruding pin disposed relative to the driver that extends into a substantially horizontal slot of the drive slide.

In forms of the invention, the driver and each unlatching cam are closely disposed (to require less space within the casing and for other reasons) with this proximity being defined in-part by the pivotal axis of the driver intersecting the unlatching cam and accordingly the cylindrical portions of each unlatching cam is supported in an aperture in a casing side walls that is within a circumference defined by the **radius r** (defined above) and in cases where the driver member takes the form of a driver annulus, each unlatching cam is within the driver annulus.

The driver as shown in Fig 4 has a **locking shoulder 160** 100 and an **unlocking shoulder 161** 101 that in a form of the member shown in the figures, is defined in-part by a **recess 162** there between. Each said shoulder is engageable by each **drive arm 163** 102 comprising a radial extension of each unlatching cam and they are spaced such that when the driver member is undisplaced and each unlatching lever is undisplaced, each drive arm abuts the locking shoulder 160 and when the lever is lifted to fully displace the driver member (to actuate the drive slides to operate remote locks) each drive arm engages the **locking shoulder 160** to displace it downwardly, and when the lever is then returned to the undisplaced position each **drive arm** abuts the unlocking shoulder 161. When the lock is unlatched by pushing the lever down, a drive arm displaces the unlocking shoulder 161 to the undisplaced position to unlatch remote locks during which displacement

the unlatching rocker is displaced to cause the latch bolt to retract. Preferably, the fully retracted latch bolt coincides with an undisplaced driver member.

In forms of locks, the drive slides comprise vertically substantially rectilinearly displaceable slides positioned towards the rear of the casing and in these forms, the second joint is connects by an angled **intermediate member 163** 103 to the **free end 164** 104 of an **intermediate rocker** 165 105 by a **pin-joint 166** 107, said rocker extending from a **pivotal joint 167** 106 shared with the casing (and located adjacent the front plate) to its **free end** disposed rearwardly of the casing. The free end also shares a **pin joint 169** 108 with a **rearwardly disposed lower drive slide 170** 109 that extends from the pin joint 169 towards the lower end of the casing. The intermediate member and rocker each have a pivotal orthogonal to a side of the casing.

In normal usage, rotation of the driver annulus in a locking direction (anti-clockwise) by lifting the free end of an unlatching lever drives the upper drive slide upwardly and the lower drive slide downwardly by causing the intermediate member to pull the rocker downwardly. Preferably the upper and lower drive slides displace simultaneously in opposite directions and preferably the total displacement of each is identical (although at any intermediate position this may not be so) and so preferably the lengths of the intermediate member, the length of the rocker and the location of the joints are configured to provide such. Rotation of the driver member in a unlocking and unlatching direction (clockwise) by lowering the free end of an unlatching lever drives the lower drive slide upwardly and the upper drive slide downwardly.

In some forms of locks as shown in Fig 5, the deadlocking slide is connected to a vertically elongated **driver locking slide 171** 110 that has a **stop shoulder 172** 111 that is displaceable into a **driver locking recess 173** 112 of the driver to restrain it from being displaced from the fully displaced position corresponding to fully outwardly displaced drive slides – this restrained configuration corresponding to a first locked configuration of the lock.

In some forms of locks, there is also a **subsidiary locking recess 174** 113 of the driver that is utilized to restrain it from being displaced from the undisplaced position (corresponding to retracted drive slides and a lock in the first locked configuration) – this form of locking being additional to the locking provided by the deadlocking slide cooperating with the bolt as described above and wherein when the bolt is restrained by the deadlocking slide, the unlatching rocker is restrained by the bolt and so each unlatching lever cannot be operated.

Although (in the locks described immediately above) there is provision for operating remote locks, it will be appreciated that they may not, and need not, always be employed with the locks described above as the locks operate quite satisfactorily without remote locks – for this reason it can be said that the remote locks or remote engaging members are operably connectable to the driver and are connectable to the drive slides because they can be connected when so desired.

In some forms of locks, the latch bolt, auxiliary bolt and locking cam are omitted to provide a lock for the fixed (first) door (that which has the strike plate attached) of a pair of French doors, said lock having one or a pair of remote bolts operated by an unlatching lever that is lockable as described above when a cylinder is included in the lock. In other forms of this lock, the lock body is adapted to include a recess for an outwardly biased locking plunger (not shown but similar to the auxiliary bolt) that is positioned adjacent the driver member that when depressed engages in a peripheral recess of the driver annulus to restrain it from being displaced from the fully displaced position corresponding to extended remote bolts. This locking plunger is depressed when the first door is closed wherein the front plate of the lock of the first door slides over the locking plunger to depress it to engage in the peripheral recess – by this means the fixed door is locked by the closing of the first door that preferably employs a lock with a latch bolt as described above.

In some forms of locks, there is means of releaseably restraining the driver member in the fully displaced position and to restrain the driver member in the undisplaced position, said means including **recesses 175** within the side of the drive annulus and a **ball 176** 116 biased towards the annulus by **spring 177** 117 wherein the spring and ball are located within a substantially **radially extended recess 178** 117 within the casing that intersects the recess for the driver annulus. When the driver annulus is in either the fully displaced or undisplaced position the ball is aligned with one of the radial recesses.

Some forms of locks include, a **lower secondary slide 179** 118 that is connected to the lower drive slide to facilitate connection to a lower vertically elongated member that is connected to a lower remote lock. In one form, the lower secondary slides comprises a screw-like threaded **fitting 180** that can receive and mate with an internally threaded end of a lower rod or tube. In some forms the lower drive slide extends vertically (within a **casing channel 181**) along the inside wall of the casing to pass through an **aperture 182** in a **horizontal wall 183** disposed towards the lower end of the casing whereupon to **dog-leg 184** so as to have the end portion halfway between the casing sides and this end portion mates within a central

axial recess 185 of a substantially cylindrical end fitting that is threaded **externally 186.**

Similarly, in some forms of locks, there is included an **upper secondary slide 187** 118A connected to the upper drive slide to facilitate connection to an upper vertically elongated member that is connected to an upper remote lock, said upper secondary slide in one form comprising a screw-like threaded **fitting 188** that can receive and mate with an internally threaded end of an upper rod or tube. In some forms the upper drive slide extends vertically along the inside wall of the casing to pass through an **aperture 189** in a horizontal **wall 190** disposed towards the upper end of the casing whereupon to **dog-leg 191** so as to have an end portion halfway between the casing sides and this end portion mates within a central axial **recess 192** of a substantially cylindrical end fitting that is threaded externally. In forms of the invention, the end fittings are within the casing when the driver member is undisplaced.

In some forms, the drive members comprises hollow tubes and the screw-like threaded fittings comprise **cylindrical members 193** connected to a **disc-like portion 194** of larger diameter that is **slotted 195** to receive the orthogonal (dog leg) portion of a drive slide and that has a axial aperture to receive the end portion of a drive slide, the slot restraining the fitting against rotation as the tube is wound onto the outer threaded portion of the cylindrical portion. The cylindrical portion is preferably connected to a **cone portion 196** through which the axial aperture extends. In other forms, the fitting comprises a cone portion having an axial aperture connected to a cylindrical member having an axial aperture to receive the end portion of a drive slide and an orthogonal side aperture to supported an outwardly biased pin that is displaceable to project into an aperture in the side of the tube whereby to become partly within both apertures whereby to connect the tube to the fitting.

The axial aperture within the cone is preferably connected at the **point 197** to a flexible elongated fitting member (in some forms comprising a **cord 198**) that can be inserted into the door along the path that it is intended to fit the tube and to extend from the wing a sufficient distance to enable the tube to be threaded onto the cord. The cord when pulled tight is then used to guide the tube into engagement with the threaded fitting by being slid along the tensioned cord.

In locks where the remote locks are connected to the main lock by Bowden Cables and the cables operate in the same direction, the lower inner cable is preferably connected to an **alternative first joint 199** that is on the opposite side of the drive member from the first joint and is substantially co-axial with the first joint and preferably comprises a pin joint. In these forms, the internal fixed portion of the

casing are adapted to provide an **open channel 200** (open from the rear of the casing) extending from the driver member towards the lower end of the casing to intersect a **receiving portion 201** to accommodate the **end 202** of the **outer cable 203** comprising a **slotted aperture 204** in a casing side wall and a **slotted aperture 205** in a fixed portion to receive **sideways protruding wings 206** of the outer Bowden cable. Similarly, The upper inner cable is preferably connected to the **first joint** and the internal fixed portions of the casing are adapted to provide a **receiving portion 207** to accommodate the **end 208** of the outer cable comprising a slotted **aperture 209** in a casing side wall and a **slotted aperture 210** in a fixed portion to receive sideways protruding **wings 211** of the outer Bowden cable.

In some forms of the above, the end of the lower Bowden cable comprises an inner **semi-flexible cable 212**, within a **rigid tube 213** of small external diameter that is connected to an outer **semi-flexible sheath 214** of larger diameter and where the inner cable has a **return portion 215** that is within an aperture in the driver member, the rigid tube is within the open channel and the larger sheath has the sideways protruding wings. In some forms, the inner cable comprises a single strand of steel wire and the rigid tube comprises steel tube.

In other forms of the invention, each drive arm and the driver locking slide is omitted and the driver annulus is operably connected to the deadlocking slide by a vertically elongated deadlocking slide extension that preferably comprises a rod that extends along the rear of the lock as does the inner Bowden Cable described above and that has a return portion at each end, one of which shares an alternative first pin joint with the annulus and the other shares a pin joint with the deadlocking slide. In this form of locks, the deadlocking slide is preferably configured to displace about 11 MM as is common in security door locks. However, if the axis of the alternative pin joint is a lesser radial distance from the axis of the annulus than the first pin joint and they are co-radial then a displacement by the deadlocking slide causes a larger displacement of the drive slides sharing first and second pin joints. By this means the drive slides can be displaced15 MM by operation of the cylinder. It will be appreciated however, that such mechanisms cannot apply forces as large as those that can be applied by an unlatching lever. In these forms of locks, the remote bolts are operated by actuation of the key and/or locking lever as is common in security door locks. The locks are configured such that the undisplaced configuration of the deadlocking slide corresponds to the undisplaced configuration of the driver annulus.

In the context of this specification, a remote lock or remote engaging means or remote engaging member all include a simple plunger like member connected directly to a vertically elongated member that is connected to a drive slide and they

all include a more sophisticated device where a remote bolt is actuated by an intermediated mechanism that in some cases includes a remote lock casing and in some cases includes means for separately deadlocking the remote bolt, wherein said independent deadlocking is effected by displacement of the associated drive slide.

The inventions herein include a means of assembling springs into the casing after the sides have been fixed, this method comprising providing apertures within a side of the casing sufficiently large to provide passage for the spring that once installed is retained within the casing by spring force and/or the casing side. The inventions herein include a means of assembling elongated drive members to drive slides of the lock.

The above described locks are configurable to have a rectilinearly displaceable bolt and:

- the upper and a lower drive slide each displace over a 15 MM range
- the bolt when fully extended protrudes 16 MM from the casing
- the bolt has a width of 13 MM
- the casing has a external width of 16 MM
- the casing internal width is 13 MM plus working clearance for the bolt
- the backset is 30 MM
- the casing depth is 41 MM
- levers that rotate less than 40 degrees to unlatch
- the distance between cylinder and lever axii of 85 MM
- the bolt is in the middle of the front plate
- the front plates are interchangeable
- the backset can be changed by the addition of spacers
- the casing length does not greatly exceed 155 MM

The above described locks are also configurable to have a pivotal bolt and:

- the upper and a lower drive slide each displace over a 15 MM range
- the bolt when fully extended protrudes 16 MM from the casing
- the bolt has a width of 10 MM
- the casing has a external width of 114 MM
- the backset is 28 MM
- the casing depth is 41 MM
- levers that rotate less than 40 degrees to unlatch
- the distance between cylinder and lever axii of 85 MM

- the front plates are interchangeable
- the casing length does not greatly exceed 155 MM

The inventions described herein are suitable for a displaceable **wing 216** 122 as *shown in Fig 26*, supported adjacent an **opening 217** 123. The wing has a **closing edge 218** 124 that is adjacent an **element 219** 125 that defines the opening when the wing is closed. In the case of hinged doors, the **free edge** of the door **220** is adjacent the **door jamb 221** 126 when the door is closed and it is on this free edge that the **lock body 222** 127 is mounted. The **lock body 222** includes a casing having a **front edge 224** (that in the forms described above comprises a front plate) and a displaceable bolt, said bolt being displaceable to a position where it protrudes from the casing relative to the front edge to engage the strike plate - the front edge including a bolt aperture to provides passage for the bolt.

Forms of the inventions include an improved **strike plate 225** 128 that comprises a substantially conventional strike plate having a **wing 226** 129 to facilitate latching, an **aperture 227** 130 to provide passage for the bolt and upper and lower portions that are attachable (usually by screws) to the element defining the opening.

The aperture of the improved strike plate includes a **front edge 228** 131 against which the bolt is urged when the door is urged in an opening direction as occurs when one attempts to force open a locked door. The substantially conventional strike plate in preferred forms, is modified to resist jemmying by enabling the portion of the strike plate adjacent the front edge to be displaced with the bolt while the portions attached to the opening remain attached to the opening while being subjected to forces that tend to pull the strike plate away from the opening and that urge the fixing screws to pull out, however the further modified strike plate subjects the screws to considerably lower forces than are applied by a conventional strike plate. The aperture of this strike plate are within a substantially flat **plate-like portion 229** 132 extending from between a **lower slot 230** 133 to an **upper slot 231** 134 and connected to the strike plate **wing 232** 133 that preferably comprises an angled or curved wing and each said slot extends from the **rear edge 233** 135 to pass between the screw aperture and aperture and preferably each slot further extends to include a **vertical portion 234** 136 between the screw aperture and wing. Importantly, the front edge of the aperture is within a portion of the strike plate that is connected to the wing so as to be displaced with the wing.

The strike plate wing is connected by **bridges 235** 137 of reduced cross-sectional area and the strike plate is of a deformable material enabling these bridges to deform without cracking and the reduced areas enables deformation to occur at

reduced forces – these characteristics enabling the wing to be angularly displaced about a **deformation axis 236** 138 that passes substantially through each bridge. If forms where the front edge is rearwardly disposed relative to this deformation axis, rotation of the wing causes the front edge to be displaced towards the wing and bolt to bring the bolt into closer engagement with the strike plate. When a jemmy blade rests on the strike plate wing as it is rotated to part the wing from the opening, the blade angularly displaces to deform the bridges and to cause the wing to rotate about the deformation axis.

The **upper and lower extremes 237** 139 of the plate-like portion (that portion between the apertures and the slots) are of reduced cross-sectional area to enable these portions to deform under low forces so as to deform as the blade portion angularly displaces about the deformation axis. When these portions are caused to engage the face of the lock they deform so as not to inhibit the displacement of the wing about the deformation axis.

The bridges connect to **fixable portions 238** 140 that include **screw apertures 239** 141 through which screws shanks have passage and by which the fixable portion is attached to the opening. In some types of deformation the fixable portions angularly displace about the screw to reduce the effective distance between bridges, and this feature combined with the fact that the wing is attached only at each to a bridge enables the wing and front edge to deform like a bow and at comparatively moderately low forces to thereby enable the front edge to displace with the bolt while the fixable portions remain attached to the opening while being subjected to reduced loads that urge the screws to pull out of the opening.

In common forms of jemmy attack, when a closed and locked door is urged open under the action of a jemmy blade placed adjacent the bolt, the bolt is forced against the front edge while the lock is simultaneously displaced away from the strike plate and as a result, the bolt (in part, as a result of friction between the bolt and front edge) causes the strike plate to deform to enable the front edge to displace with it.

Where the bolt comprises a pivotal bolt, in some forms it is defined in part by an **outer radius R** referenced from the bolt pivotal axis, a general thickness T (excluding recesses) and a **leading edge 301** that is displaceable from the casing. Within at least one side of the bolt, between the pivotal axis and outer edge, extending from the leading edge is a **side recess 302** that is preferably defined by an outer **recess radius r** that does not extend to the outer edge and so leaving a sideways **relatively protruding shoulder 303** ("relatively" meaning that the shoulder may be within the general thickness but in relation to the adjacent side recess it comprises a sideways protruding shoulder).

The relatively protruding shoulder preferably comprises an **arcular shoulder 304** defined in-part by the outer radius R and defined in-part by the recess radius r of the adjacent preferably, substantially planar side recess; and the side recess is preferably planar and defined by a normal vector that is parallel to the pivotal axis of the bolt. The plane of the side recess, relative to the general shape of the bolt, is at a **depth t.**

The relatively protruding shoulder thereby having a **radial width of R-r** and a relative height of t and the thickness of the bolt through the recess (herein called the **web thickness**) is equal to **T-t.**

Preferably each side of the bolt is profiled as described above so that the width of the bolt between side recesses is **T – 2t.**

Although preferable (that in general) the outer edge of the bolt has a constant radius R, and the side recess be defined by a constant radius these configurations are not essential to the inventions herein. However, this form provides the advantage that the strike plate, once aligned to enable the bolt to enter the entry aperture will provide free passage to the bolt over its full range of displacement; and if the bolt is displaced relative to the strike plate when in the fully extended position to become in contact with the strike plate, it can be displaced to withdraw from the strike plate aperture without having to in any way deform the strike plate. If the bolt is also urged against the strike plate it can be displaced (by overcoming frictional forces) to withdraw from the strike plate aperture and again without having to deform the strike plate.

The bolt described above requires an improved **engageable means** that for hinged doors comprises the **strike plate 305**, that in one form comprises a substantially conventional strike plate having a **wing 306** to facilitate latching, an **aperture 307** to provide passage for the bolt and having a **peripheral edge 308** and **upper 309** and **lower 310** portions that are attachable (usually by screws) to the element defining the opening.

The aperture however, is adapted to include an **entry aperture 311** having a substantially conventional width (to allow entry of the protruding shoulder with a little clearance) and a lower **offset recess 312** connected to the entry aperture but being of reduced width to allow entry of just the web of the bolt with a little clearance. The width of this offset recess is less than T but greater than T – t or T-2t, depending on whether the bolt has one or two side recesses.

The bolt and strike plate dimensions are configured such that during latching each annular shoulder enters the entry aperture and the web enters the offset recess. When the bolt is fully extended a portion of each annular shoulder

horizontally overlaps a peripheral edge of the offset recess – and if one ignores relatively small working clearances by t.

A lock as described above having a given outer radius, given side recess radius and pivotal axis and casing, fitted within a wing and having the strike plate described above attached to the opening, will be separated (when the wing is closed) by **a gap 313.** In practice, this distance should not exceed (herein defined as) a **"maximum gap"** and related to this maximum gap is a predetermined (herein defined) **minimum overlap** and when the lock and strike plate are more closely disposed the overlap will be greater than it is for the maximum gap. Preferably the bolt and strike plate aperture are configured to maximize the minimum overlap while observing other considerations described below

It will also be appreciated from looking at the figures that the larger is r the larger will be the overlap; and the larger is r the weaker will be the protruding shoulder that has a width of R-r. Preferably (and for other reasons) r can be maximized but not so as to undesirably weaken the shoulder.

When the lock is a lock for hinged doors and the improved bolt takes the form of a latch bolt having a pre-latching configuration, the portion of the bolt defined in-part by the intersection of the leading edge and the outer edge of one side of the protruding shoulder is preferably radiused, spherical or otherwise **curved or profiled 314** whereby to provide a radiused, spherical or otherwise curved or profiled side for the partly extended latch bolt to enable this portion to slide up the wing of the strike plate during latching (and as the bolt angularly displaces) to be inwardly depressed by the strike plate from the partly extended pre-latching configuration. For practical reasons, it is preferable that both sides of the bolt be so configured to suit both left hand and right hand hinged doors. In some

Because wings sometimes drop after fitting and because of wing installation errors it is preferable that the bolt and strike plate properly engage within a range of vertical relative disposition and in practice it has been found necessary for this range to extend from –4MM to +4MM about a nominal central position. This means that the bolt must be able to enter and withdraw from the aperture and overlap the aperture when engaged. So the bolt and strike plate of the inventions are further configured to function correctly and to have maximum "minimum overlap" within the range from 4MM below the nominal central position to 4MM above while observing other considerations described below as shown in Fig 38 and Fig 39.

The derived improved catch plate has a substantially rectangular entry aperture having an upper edge (excluding working clearances) in horizontal alignment with the upper edge of the bolt when the gap is zero and the strike plate is

relatively disposed at – 4MM from the central position. The lower edge of the entry aperture is in contact with (to be limited by) the inner wall of the protruding shoulder of the bolt when the gap is maximum and the strike plate is relatively disposed at + 4MM from the central position. The lower end of the offset aperture is substantially horizontally aligned with the leading edge when the bolt is fully extended and the strike plate is relatively disposed at + 4MM from the central position.

By configuring in this way, an overlap is obtained that meets all the criteria and that is significantly greater than the overlay of the hook of the bolt of [Watts 633318].

For practical reasons, the aperture is further configured so as to suit both left hand and right hand hinged doors and so the aperture is further configured to be a mirror image about a plane through the centre of the entry aperture and to have an upwardly extending **second offset 315** recess that is only used if the strike plate is inverted.

In forms of the invention offset aperture edge is further configured so that when the gap is maximum and the strike plate is central, the **inside edge 316** of the side shoulder is in contact with the strike plate underside that has been formed to mate with the bolt over an extended distance; i.e. this portion of the strike plate is not flat and has been formed by being displaced away from the lock casing so as to have a greater area of contact with the bolt.

Although the description above (and including earlier description relating to 66618) refers to a lock for hinged wings that may comprise doors, and having a bolt and a strike plate having a wing, the material is equally as relevant to a lock for sliding wings having a catch plate with an aperture as described above. (The catch plate in one form comprise the improved strike plate described above but because it is unnecessary for a sliding wing to employ a wing, this is omitted in some forms, in other forms again, the aperture may be displaced from the wing opening to provide clearance for the bolt to fit between the opening and underside of the catch plate aperture.)

When doors are jimmied or burst open, it is common for the bolt to be displaced longitudinally from the aperture and in locks having rectilinearly displaceable bolts there is nothing to stop the bolt from being rectilinearly displaced from the aperture while the opening and closing edge of the wing are forced relatively apart. Where the bolt and strike plate take the preferred form described above, each sideways protruding shoulder locates behind a peripheral edge of the offset aperture so that attempted relative horizontal displacement to part the wing and opening brings the inside edge of the protruding shoulder and inside side wall into contact

with the edge of the offset recess so that that the strike plate is able to provide a force resisting further relative displacement. If the forces applied are sufficiently large, further relative displacement will occur causing the portion of the strike plate plate adjacent the offset recess to be displaced with the bolt.

The apertures of the improved strike plate include the front edge 308 (said edge including the front edge of the entry aperture and/or the front edge of the offset apertures) against which the bolt is urged when the door is urged in an opening direction as occurs when one attempts to force open a locked door. The substantially conventional strike plate in preferred forms, is further modified to resist jemmying by enabling the portion of the strike plate adjacent the offset recess to be displaced with the bolt while the portion attached to the opening remain attached to the opening while being subjected to forces that tend to pull the strike plate away from the opening and that urge the fixing screws to pull out, however the further modified strike plate subjects the screws to considerably lower forces than are applied by a conventional strike plate. The apertures of this strike plate are within a substantially flat **plate-like portion 316** extending from between a **lower slot 317** to an **upper slot 318** and connected to the strike plate wing 306 that preferably comprises an angled or curved wing and each said slot extends from the **rear edge 318** to pass between the fixing aperture and offset aperture and preferably each slot further extends to include a **vertical portion 319** between the screw aperture and wing. Importantly, the front edge of the aperture is within a portion of the strike plate that is connected to the wing so as to be displaced with the wing.

The strike plate wing is connected by **bridges 320** of reduced cross-sectional area and the strike plate is of a deformable material enabling these bridges to deform without cracking and the reduced areas enables deformation to occur at reduced forces – these characteristics enabling the wing to be angularly displaced about a **deformation axis 321** that passes substantially through each bridge. If forms where the front edge is rearwardly disposed relative to this deformation axis, rotation of the wing causes the front edge to be displaced towards the wing and bolt to bring the bolt into closer engagement with the strike plate. When a jemmy blade rests on the strike plate wing as it is rotated to part the wing from the opening, the blade angularly displaces to deform the bridges and to cause the wing to rotate about the deformation axis.

The **upper and lower extremes 322** of the plate-like portion (that portion between the apertures and the slots) are of reduced cross-sectional area to enable these portions to deform under low forces so as to deform as the blade portion angularly displaces about the deformation axis. When these portions are caused to

engage the face of the lock they deform so as not to inhibit the displacement of the wing about the deformation axis.

The bridges connect to fixable portions 310 and 309 include **screw apertures 323** through which screws shanks have passage and by which the fixable portion is attached to the opening. In some types of deformation the fixable portions angularly displace about the screw to reduce the effective distance between bridges, and this feature combined with the fact that the wing is attached only at each to a bridge enables the wing and front edge to deform like a bow and at comparatively moderately low forces to thereby enable the front edge to displace with the bolt while the fixable portions remain attached to the opening while being subjected to reduced loads that urge the screws to pull out of the opening.

In common forms of jemmy attack, when a closed and locked door is urged open under the action of a jemmy blade placed adjacent the bolt, the bolt is forced against the front edge while the lock is simultaneously displaced away from the strike plate and as a result, the bolt (in part, as a result of friction between the bolt and front edge) causes the strike plate to deform to enable the front edge to displace with it.

Other alternative forms of bolt are feasible such as sideways protruding cylindrical shoulders projecting from a generally planar form but this form has less strength and there is the risk of the shoulders being "caught" within the aperture as the bolt is displaced to withdraw from the aperture, and particularly if the bolt is not perfectly aligned with the catch plate. This form of bolt also provides less resistance to bending about an axis through the front edge of the lock body and therefore is more likely to bend when an attempt is made to force open a wing. Alternatively, the web can be omitted from the bolt but a bolt so constructed when urged horizontally from the aperture is more likely to deform to release the catch plate.

Complete locks (complying with common functionality requirements) and comprising a combination of the integers described above

Passage Lock, F75 latch bolt operated by lever from either side at all times.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), an unlatching cam or a pair of such, an unlatching rocker, interior and exterior levers connected to a single shaft, it does not have a cylinder or a locking member and the deadlocking slide and locking cam can be omitted from the lock

Privacy, F76 G2 and 3 a latch bolt operated by lever from either side except when levers are locked by locking lever (snib) on inside.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), an unlatching rocker and a single shaft, an interior locking member and a deadlocking slide, a lockable exterior lever (having a stop slide) and an interior lever each connected by separate shafts to separate unlatching cams.

In this lock, the exterior handle set is adapted to include an exterior locking lever comprising hand operable coin slot that is connected to the locking cam by an additional spindle

Patio, F77 G2 and 3 deadlocking latch bolt operated by lever from either side except when outside lever is locked by snib locking lever on inside. Automatic unlocking when inside lever is rotated or unlocked by locking lever.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), unlatching rocker, a locking member, a locking cam and an adapted deadlocking slide having a deadlocking shoulder and a ramped unlatching portion, a lockable exterior lever and an interior lever each connected by separate shafts to separate unlatching cams.

Entrance, F 81 deadlocking latch bolt operated by lever from either side except when outside lever is locked by locking lever on inside. When outside lever is locked, latch bolt is retracted by employing exterior key to displace the deadlocking slide to the undisplaced position to enable the exterior lever to be operated or rotating interior lever. Locking lever must be operated to unlock exterior lever.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), unlatching rocker, a locking member, a cylinder with a key operable barrel and an adapted deadlocking slide having a deadlocking shoulder and ramped unlatching portion, a lockable exterior lever and an interior lever each connected by separate shafts to a separate unlatching cam and no locking cam and the spindle passes through an aperture in the casing to mesh in lever locking cam 76 of the exterior handle assembly. The casing in this function is modified by the inclusion of a casing shoulder to prevent the cylinder from displacing the deadlocking slide from the third locked configuration to the first locked configuration.

Entrance, F82 G 1 deadlocking latch bolt operated by lever from either side except when outside lever is locked by locking lever on inside. When outside lever is locked, the exterior lever may be operated after unlocking by key or by rotating interior lever which unlocks the exterior lever.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), unlatching rocker, a locking member, a cylinder with an exterior key operable barrel and an adapted deadlocking slide having a deadlocking shoulder and ramped unlatching portion, a lockable exterior lever and an interior lever each connected by separate shafts to a separate unlatching cam and a locking cam and the spindle passes through the locking cam to mesh with it and then mesh in the lever locking cam 76 of the exterior handle assembly. The casing in this function is modified by the inclusion of a casing shoulder to prevent the cylinder from displacing the deadlocking slide from the third locked configuration to the first locked configuration.

Classroom, F84 deadlocking latch bolt operated by lever from either side except when outside lever is locked by key from exterior. When outside lever is locked, latch bolt retracted by rotating interior lever or by unlocking exterior lever by key and then operating exterior lever.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), unlatching rocker, a cylinder with an exterior key operable barrel and an adapted deadlocking slide having a deadlocking shoulder and ramped unlatching portion, a lockable exterior lever and an interior lever each connected by separate shafts to a separate unlatching cam and a the spindle that passes through an aperture in the casing to mesh in the lever locking cam 76 of the exterior handle assembly. The casing in this function is modified by the inclusion of a casing shoulder to prevent the cylinder from displacing the deadlocking slide from the third locked configuration to the first locked configuration.

F91 deadlocking latch bolt operated by lever from either side except when both levers are locked by key from either side.

The lock has an outwardly biased latch bolt and an auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without hooks) or a pivotal bolt), an unlatching rocker, a cylinder with interior and exterior key operable barrels, deadlocking slide, an exterior lever and an interior lever each connected to an unlatching cam by a single shaft. The improved lock, subject of this specification also has provision for interior locking by lever wherein the lock may electively include a locking cam, locking member and a spindle that interconnects each to the other.

Night latches having automatic deadlocking when the wing is closed.

The deadlatching latch bolt is operated by lever from either side when lock is unlocked. The lock has an outwardly biased deadlocking latch bolt and a triggering auxiliary bolt (the bolt comprising a chamfered bolt or a prism bolt (with or without

hooks) or a pivotal bolt), an unlatching rocker, a locking member, a cylinder with an exterior key operable barrel and an alternative spring biased deadlocking slide, an exterior lever and an interior lever each connected by a single shaft to an unlatching cam. The casing in this function is modified by the inclusion of a casing shoulder to prevent the cylinder from displacing the alternative deadlocking slide to the first locked configuration. The lock is unlocked by key from either side to enable either lever to retract the bolt. The lock may also include a locking member and locking cam by which to unlock the lock.

The cylinders within the locks described above, (except for F91 which absolutely requires such) electively additionally include an interior key operable barrel OR an hand operable turn knob

The improved locks described above, all have provision to operate remote locks.

Multipoint Locks with provision to connect to upper and lower remote locks by vertically displaceable counteracting drive members that displace simultaneously in the opposite direction.

These locks include a driver member within the casing located adjacent each unlatching cam to be displaceable by each unlatching cam to displace an upper and/or lower driver slide to which drive members can be connected (to operate remote engaging members). The locks further include a latch bolt (either rectilinearly displaceable or pivotal), unlatching rocker, deadlocking slide, locking cam and locking member, a double free-rotation-cylinder, and interior and exterior levers connected by a single shaft to the unlatching cams (or single cam), said levers being rotated upwards to latch (in some cases to outwardly displace remote engaging members) remote locks and downwards to unlatch the lock while simultaneously unlatching the remote locks. The locks preferably include a driver locking slide so that in the first locked configuration, the driver is restrained against rotation. The locks alternatively have levers connected by separate shafts to separate unlatching cams and the exterior lever is lockable and the deadlocking slide comprises an adapted deadlocking slide.

In other forms of these locks, there is a driver member within the lock casing located adjacent each unlatching cam to be displaceable by each unlatching cam to displace an upper and/or lower driver slide to which drive members can be connected to operate remote engaging members. The locks further include a latch bolt, unlatching rocker, deadlocking slide, a double free rotation cylinder, and interior and exterior levers connected by a single shaft to the unlatching cams, said levers being rotated downwards to unlatch the lock while simultaneously unlocking remote

locks. In these forms, the driver is connected to the deadlocking slide by a deadlocking slide extension to be displaceable by cylinder.

In other forms of these locks, there is provision to connect to upper and lower remote locks by vertically displaceable drive members comprising Bowden Cables that displace simultaneously in the same direction.

The Claims defining the Invention Are:

Driver to operate remote bolts

'1 A lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

an angularly displaceable driver operably connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

at least one hand operable angularly displaceable lever having a free end and at least one angularly displaceable unlatching cam to operably connect the bolt and driver to the at least one lever,

wherein the bolt is displaceable towards the casing by downward displacement of the free end and each connected drive member is displaceable towards and away from the casing by displacement of the free end.

'2 A lock according to Claim 1, wherein the pivotal axis of the diver intersects through the unlatching cam.

'3 A lock according to Claim 1, wherein the diver comprises a substantially annular member supported within a substantially circular recess.

'4 A lock according to Claim 1, wherein the bolt is rectilinearly displaceable

'5 A lock according to Claim 1, wherein the bolt is angularly displaceable

Exterior handle locking – and adapted locking slide

'20 A lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the bolt towards the retracted position including an exterior and an interior hand operable lever operably connected to the bolt by angularly displaceable means,

an adapted locking slide and a hand operable locking member that is operable to displace the said adapted locking slide, said adapted locking slide being displaceable by the locking member to a third locked configuration corresponding to the exterior lever being locked to be restrained against displacement,

said adapted locking slide being displaceable from the third locked configuration to unlock the exterior lever by displacement of the interior lever.

'21 A lock according to Claim 20 wherein the angularly displaceable means comprises an angularly displaceable unlatching rocker.

'22 A lock according to Claim 20, wherein the bolt is rectilinearly displaceable

'23 A lock according to Claim 20, wherein the bolt is angularly displaceable

Exterior handle locking – and adapted dead locking slide

'25 A lock including a casing, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the bolt towards the retracted position including an exterior and an interior hand operable lever operably connected to the bolt by angularly displaceable means,

an adapted dead locking slide and a hand operable locking member that is operable to displace the said adapted locking slide, said adapted dead locking slide being displaceable by the locking member to a third locked configuration corresponding to the exterior lever being locked to be restrained against displacement,

said adapted dead locking slide being displaceable from the third locked configuration to unlock the exterior lever by displacement of the interior lever.

'26 A lock according to Claim 25 wherein the angularly displaceable means comprises an angularly displaceable unlatching rocker.

'27 A lock according to Claim 25, wherein the bolt is rectilinearly displaceable

'28 A lock according to Claim 25, wherein the bolt is angularly displaceable

Cylinder displaces driver

'30 A lock including a casing with sides, a bolt supported in the casing to be displaceable between a fully extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

an angularly displaceable driver operablely connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

deadlocking means by which to restrain the bolt in the fully extended position including a key operable cylinder and a deadlocking slide that is connected by a deadlocking slide extension to the driver,

said deadlocking slide being displaceable by the cylinder to displace the driver whereby to displace each connected drive member towards and away from the casing.

'31 A lock according to Claim 30, wherein the bolt is rectilinearly displaceable

'32 A lock according to Claim 30, wherein the bolt is angularly displaceable

Automatically locking lock

'40 A lock including a bolt comprising a latch bolt having an alternative associated auxiliary bolt supported in the casing, said bolt being displaceable between a fully

extended position where the bolt protrudes from the casing and a retracted position in which it is substantially within the casing,

operating means by which to displace the latch bolt towards the retracted position including an angularly displaceable unlatching rocker operably associated with an exterior and interior hand operable lever,

deadlocking means to restrain the latch bolt in the fully extended position including an alternative locking slide (without an unlatching ramped portion) biased towards the bolt and a cylinder including a key operable barrel that is operably connected to the alternative locking slide,

said alternative locking slide having a horizontally elongated ramped shoulder projecting towards the alternative auxiliary bolt with a horizontal engageable face, said alternative auxiliary bolt also includes a horizontally elongated ramped shoulder projecting towards to deadlocking slide with a horizontal engageable face projecting towards to deadlocking slide,

said alternative auxiliary bolt rearward end being biased and displaceable towards the alternative locking slide; the arrangement being configured such that in a pre-latching configuration, the engageable face of the alternative locking slide is above the engageable face of the alternative auxiliary bolt and the alternative locking slide abuts the bolt to be restrained by the bolt; in the third locked configuration the alternative locking slide lies behind the bolt to deadlock the bolt such that it cannot be retracted by lever operation and the alternative auxiliary bolt is substantially depressed, at which time

the cylinder can be operated to displace the alternative locking slide to the undisplaced position during which displacement the ramped engageable horizontal face of the slide passes over the ramped engageable horizontal face of the auxiliarly bolt by displacing the auxiliary bolt sideways against spring bias, said auxiliary bolt subsequently ramped engageable horizontal face being displaced towards the alternative locking slide to engage the said slide,

subsequent displacement of the auxiliary bolt as the auxiliary bolt displaces to the fully extended position causes the ramped engageable horizontal face of the bolt to displace from above the ramped engageable horizontal face of the alternative locking slide to thereby release the slide to assume the position corresponding to the pre-latching configuration.

'41 A lock according to Claim 40, wherein the bolt is rectilinearly displaceable

'42 A lock according to Claim 40, wherein the bolt is angularly displaceable

Fixed door lock

'60 A lock including a casing having a front plate, an angularly displaceable driver operablely connectable to an upper remote engaging member by an upper vertically elongated drive member and/or connectable to a lower remote engaging member by a lower vertically elongated drive member,

at least one hand operable angularly displaceable lever having a free end and at least one angularly displaceable unlatching cam to operably connect the driver to the at least one lever, each connected drive member being displaceable towards and away from the casing by displacement of the free end,

said lock further including a locking plunger that protrudes from the front to be displaceable to engage in a recess in the driver whereby to restrain the driver against displacement.

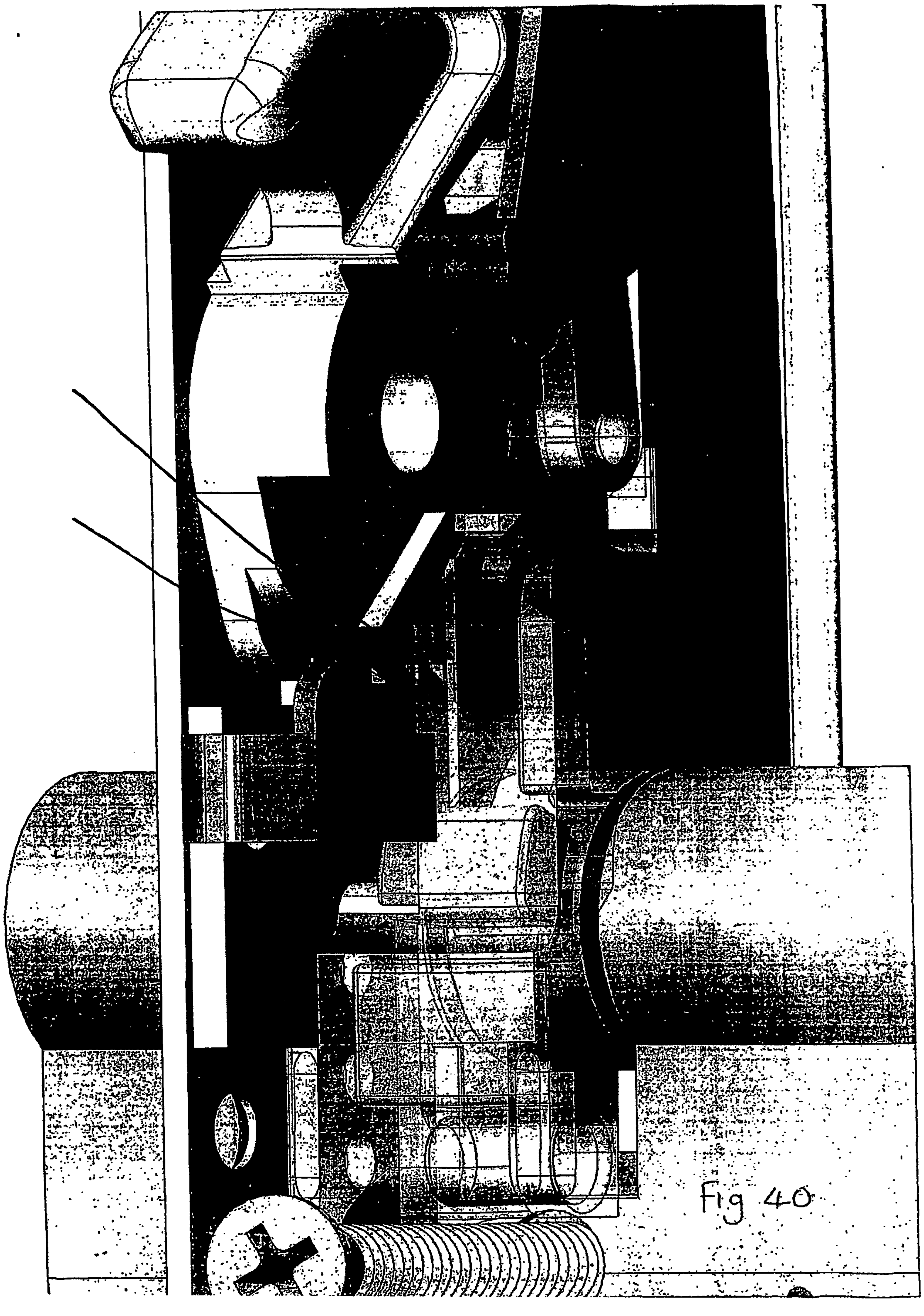
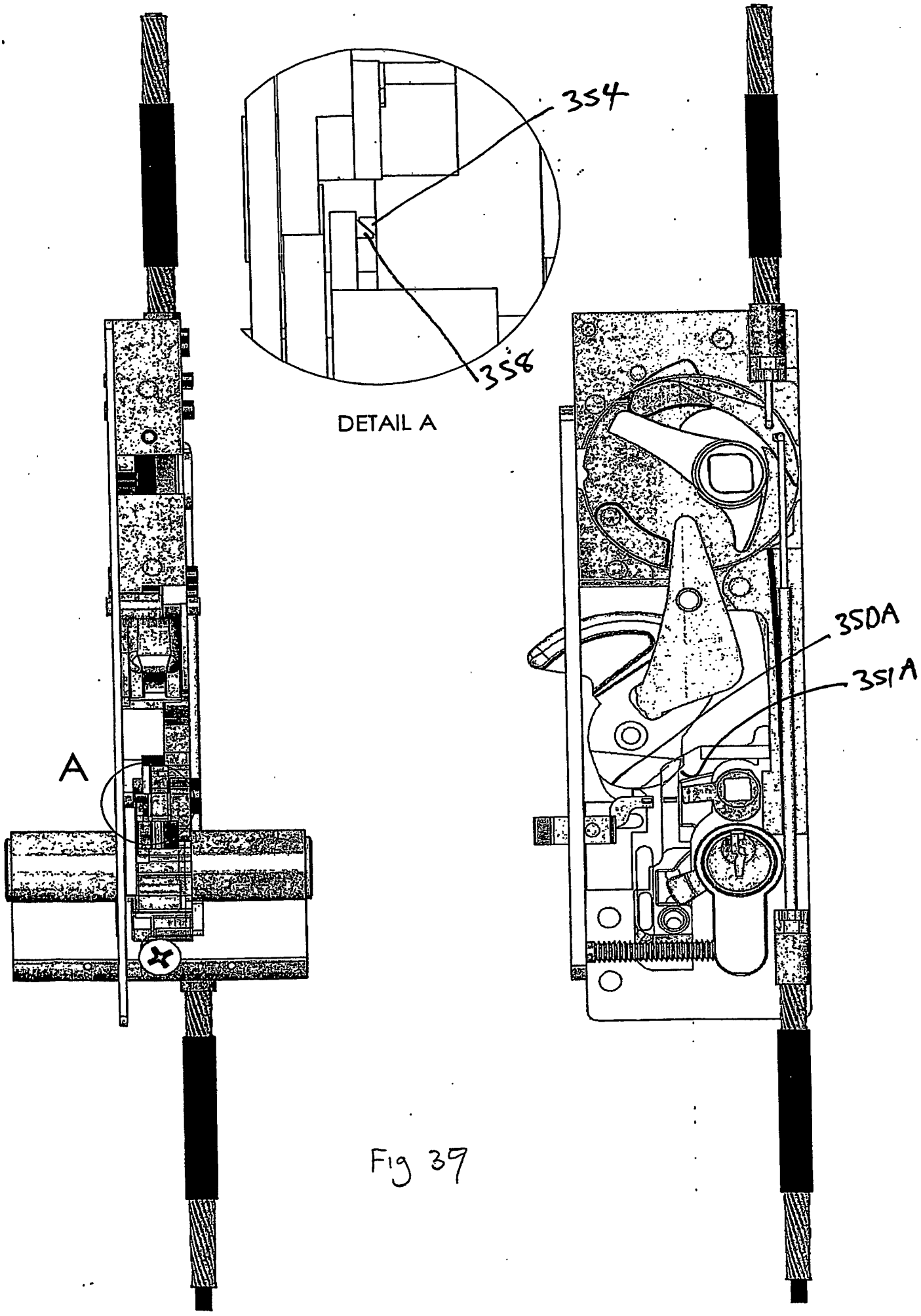


Fig 40



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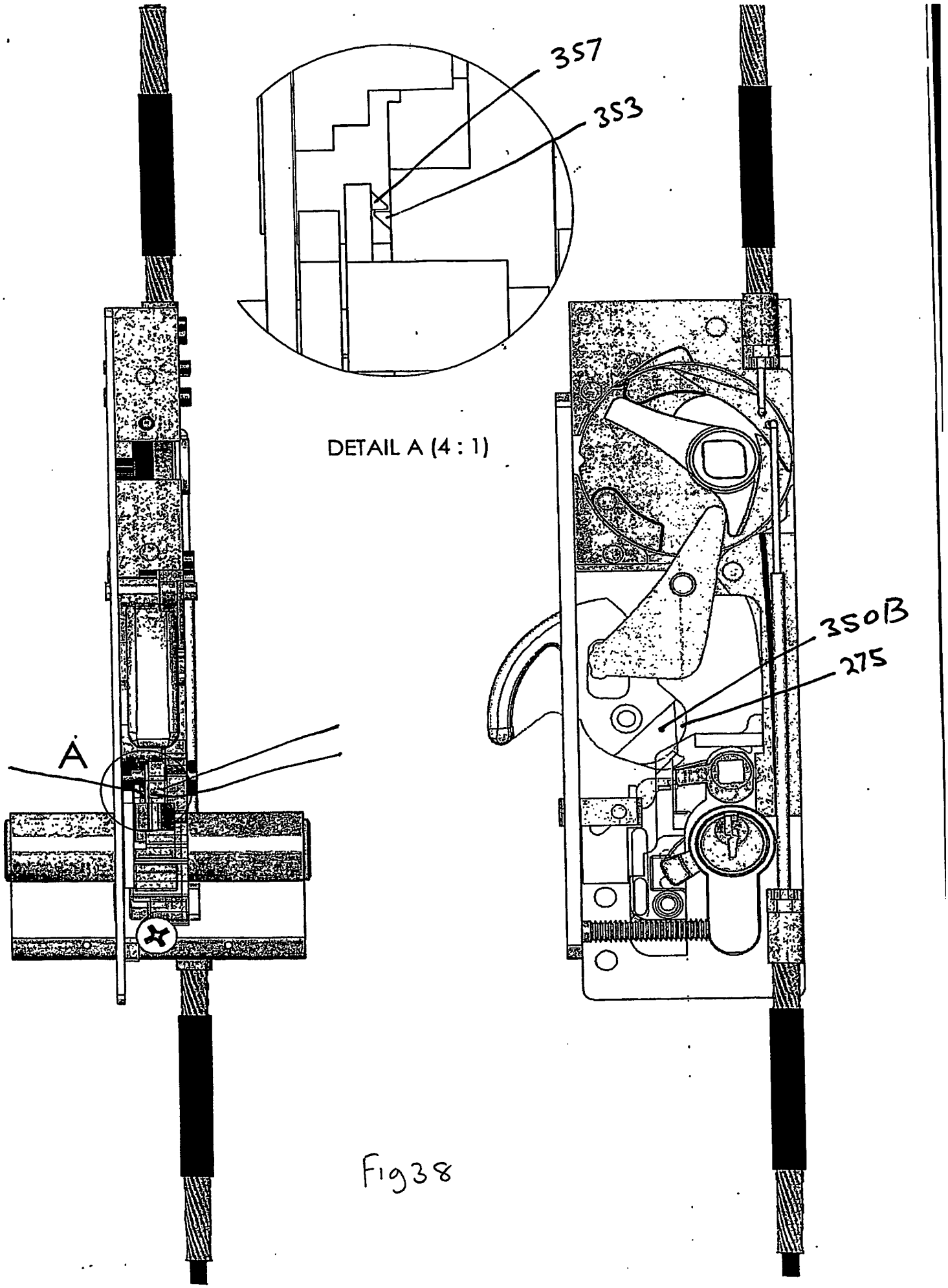

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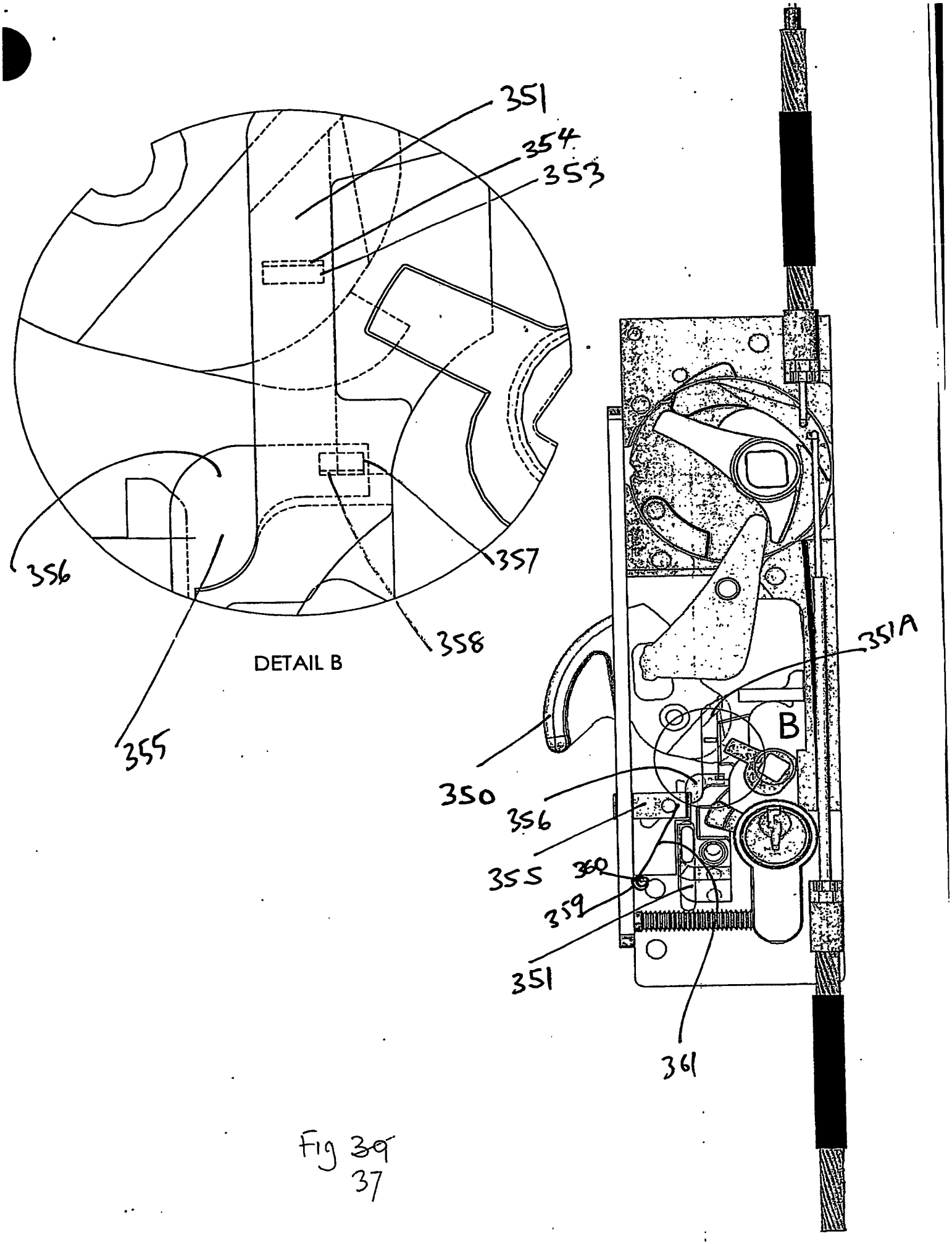
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Fig 39
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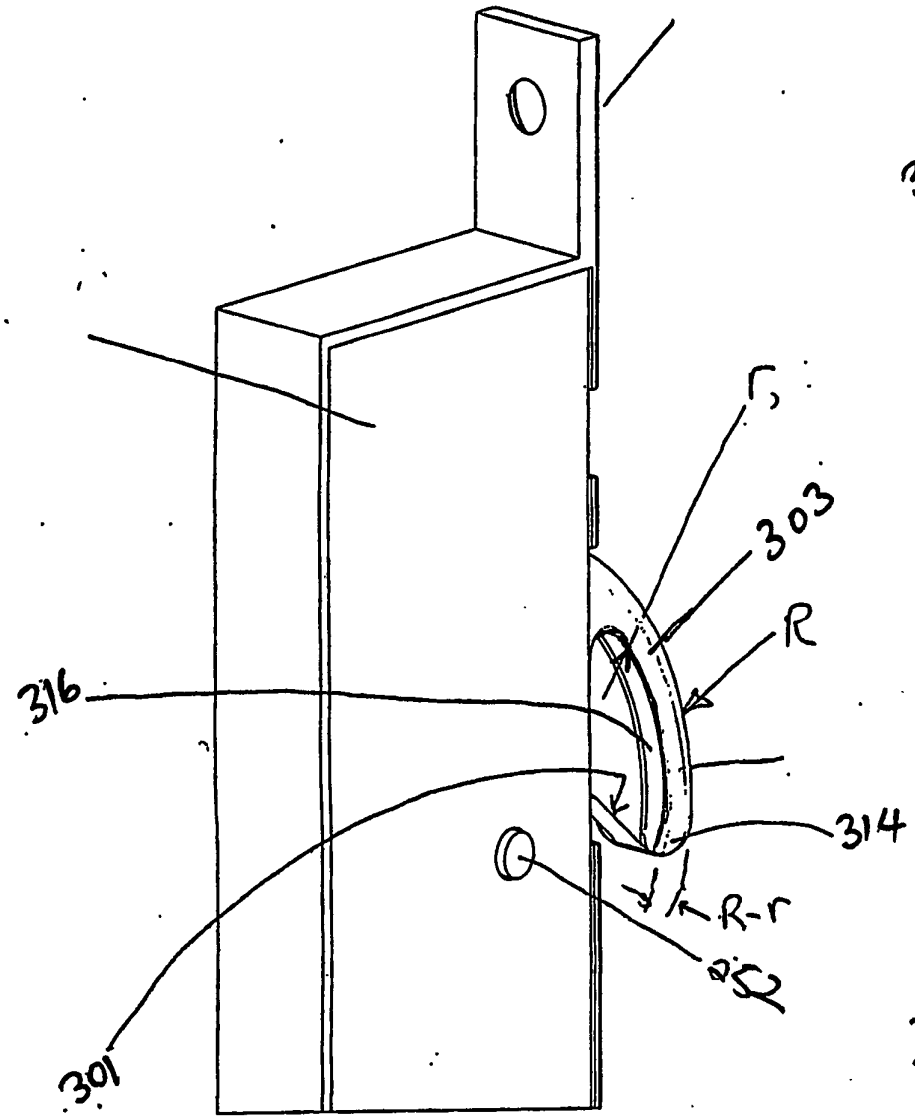

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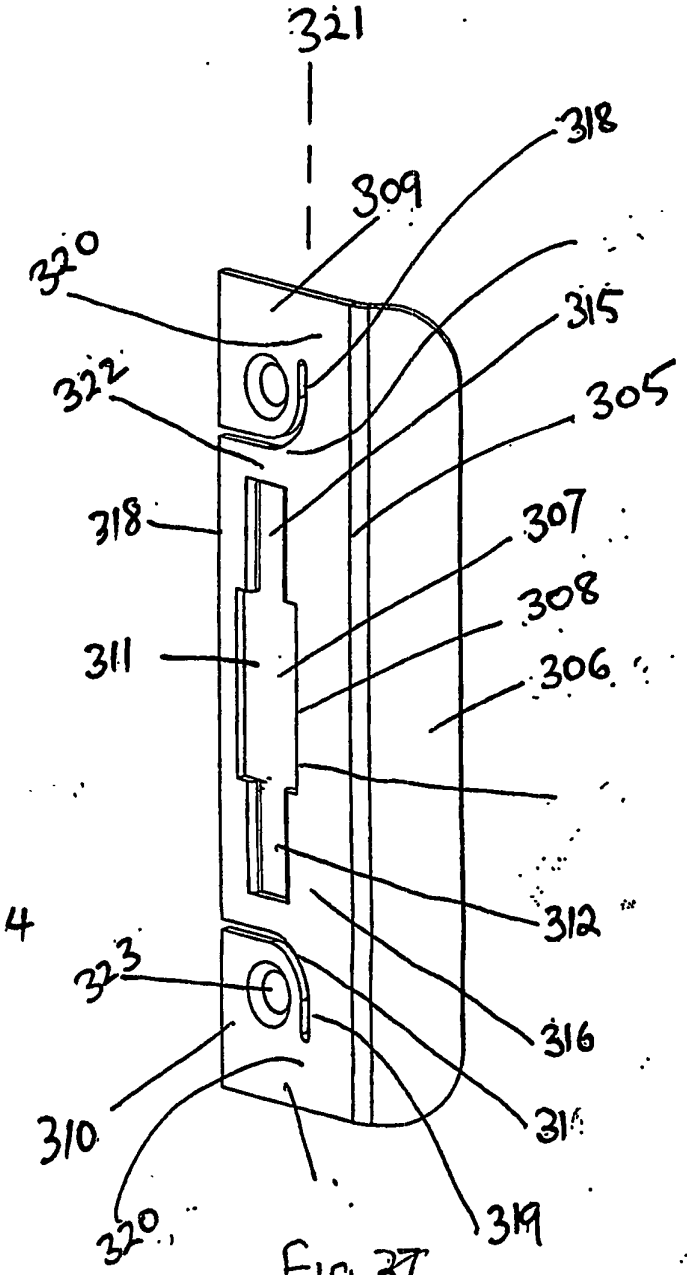

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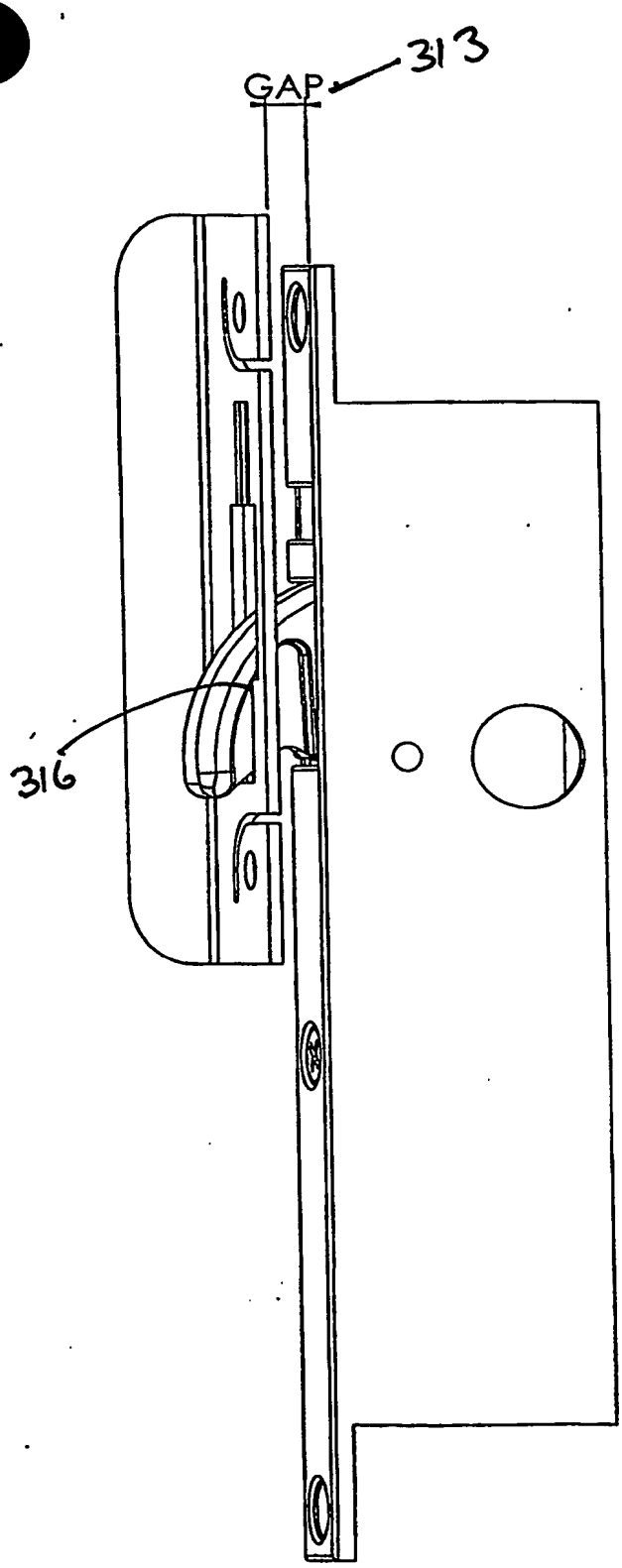

Fig 3E
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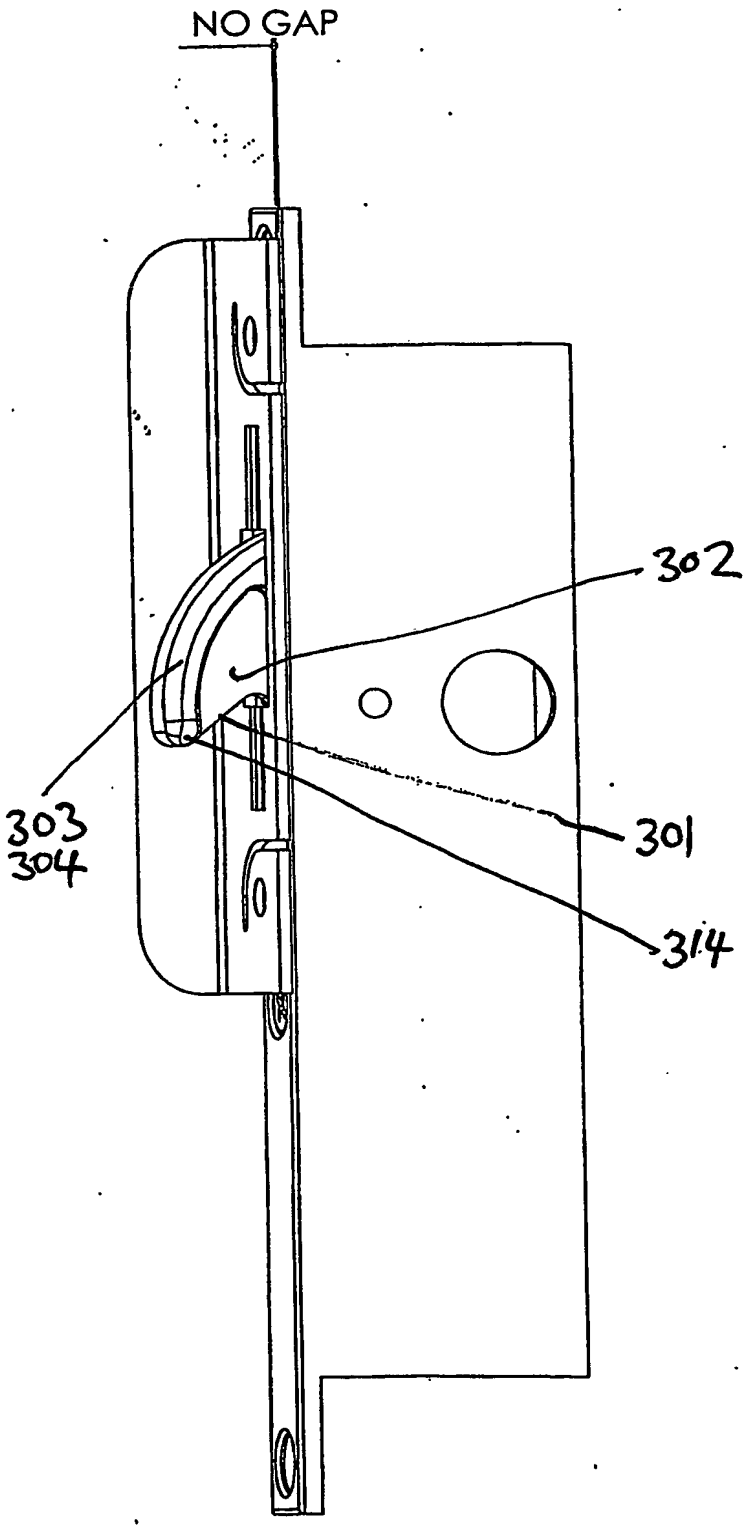

Fig 3F
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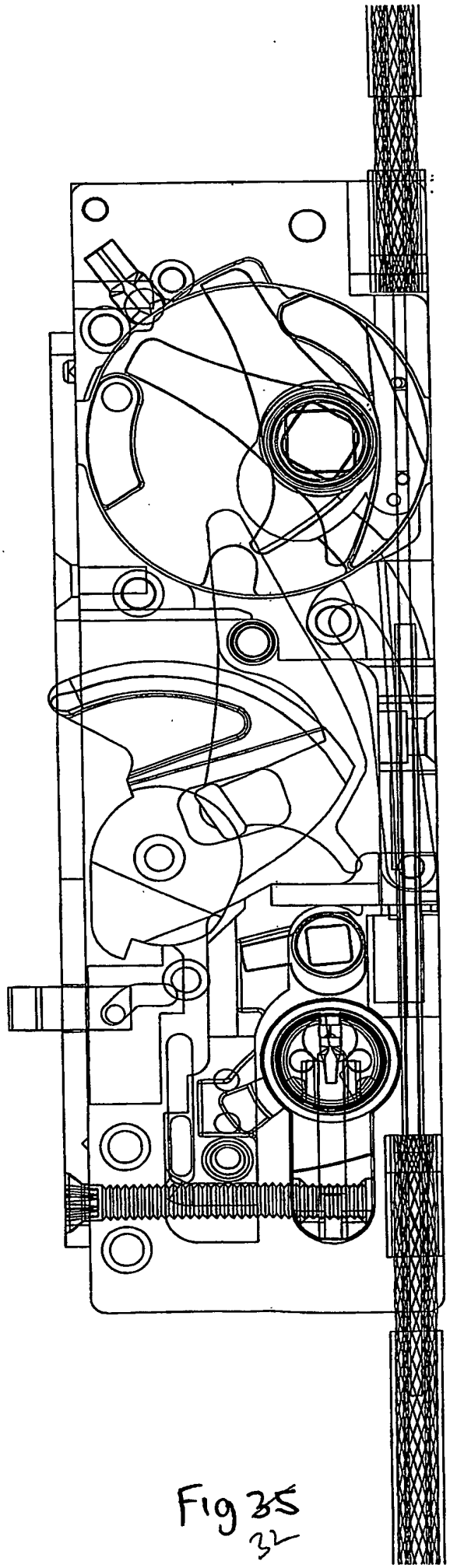

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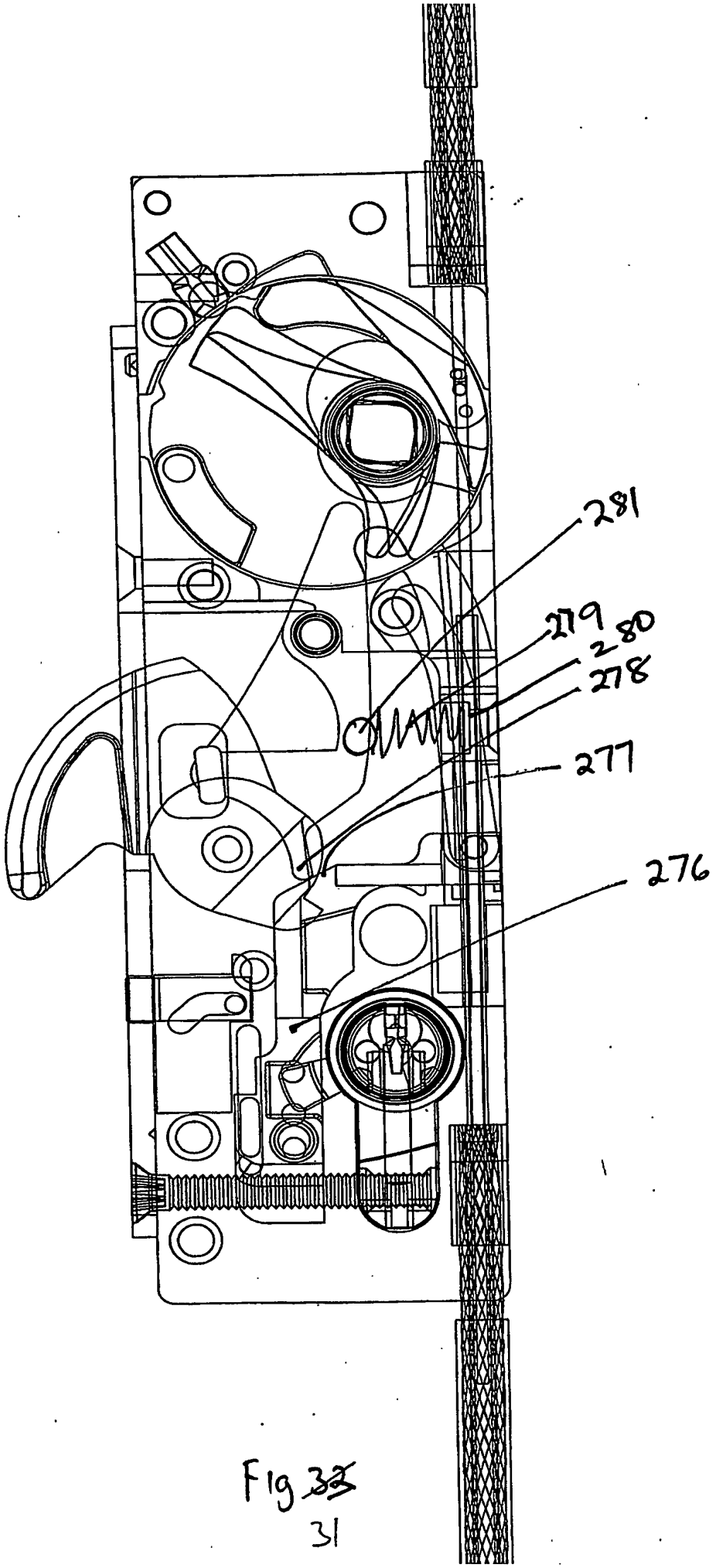

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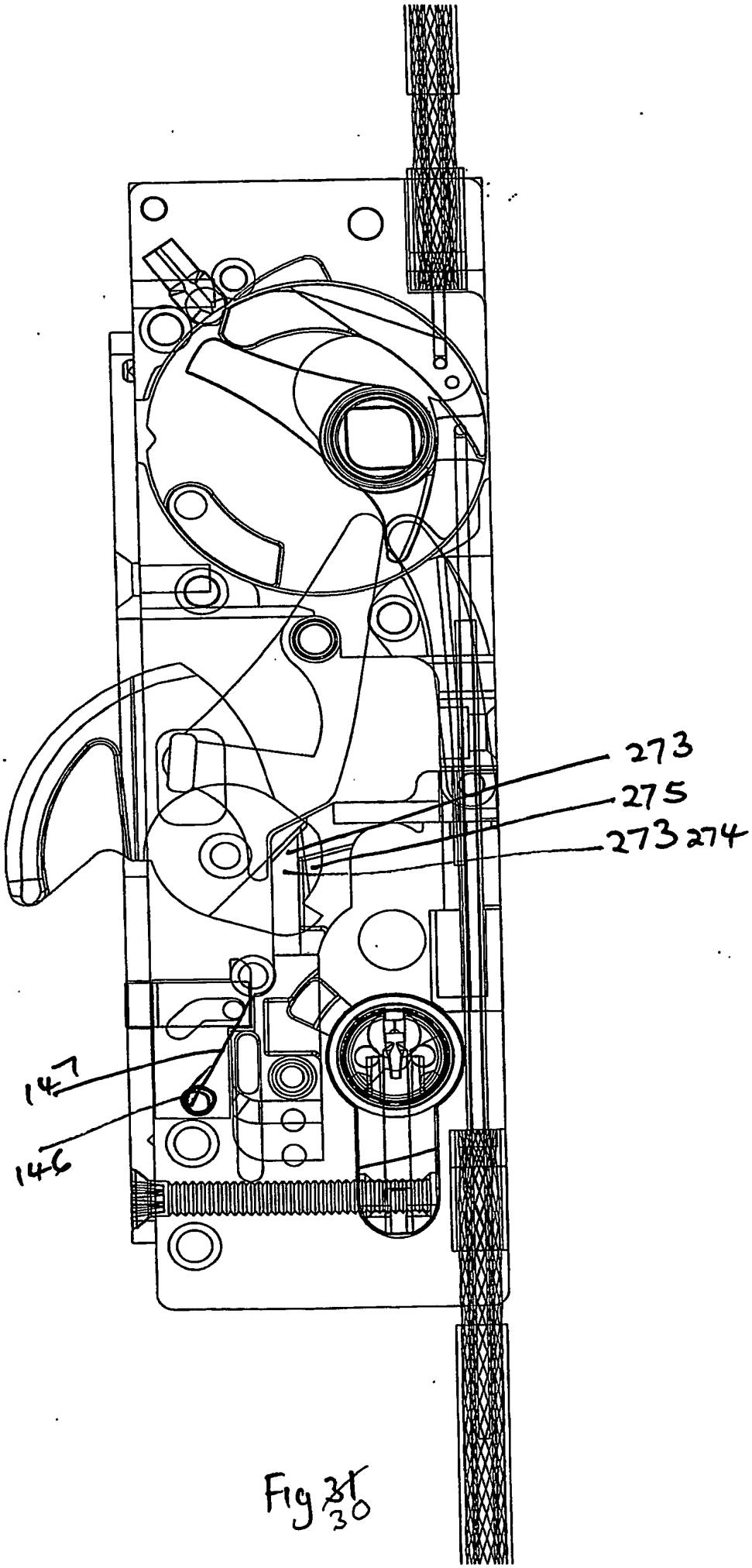

Fig 31
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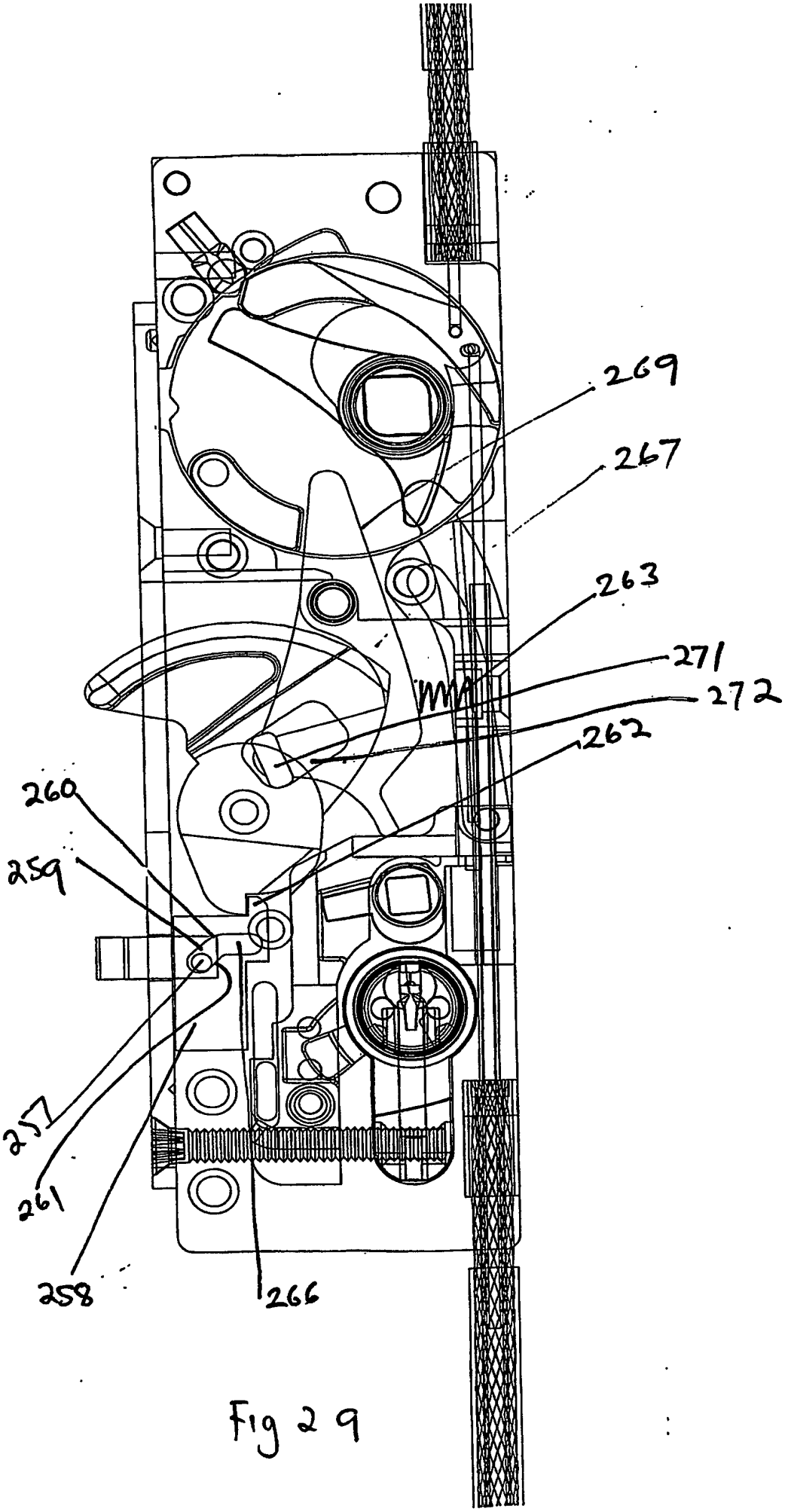
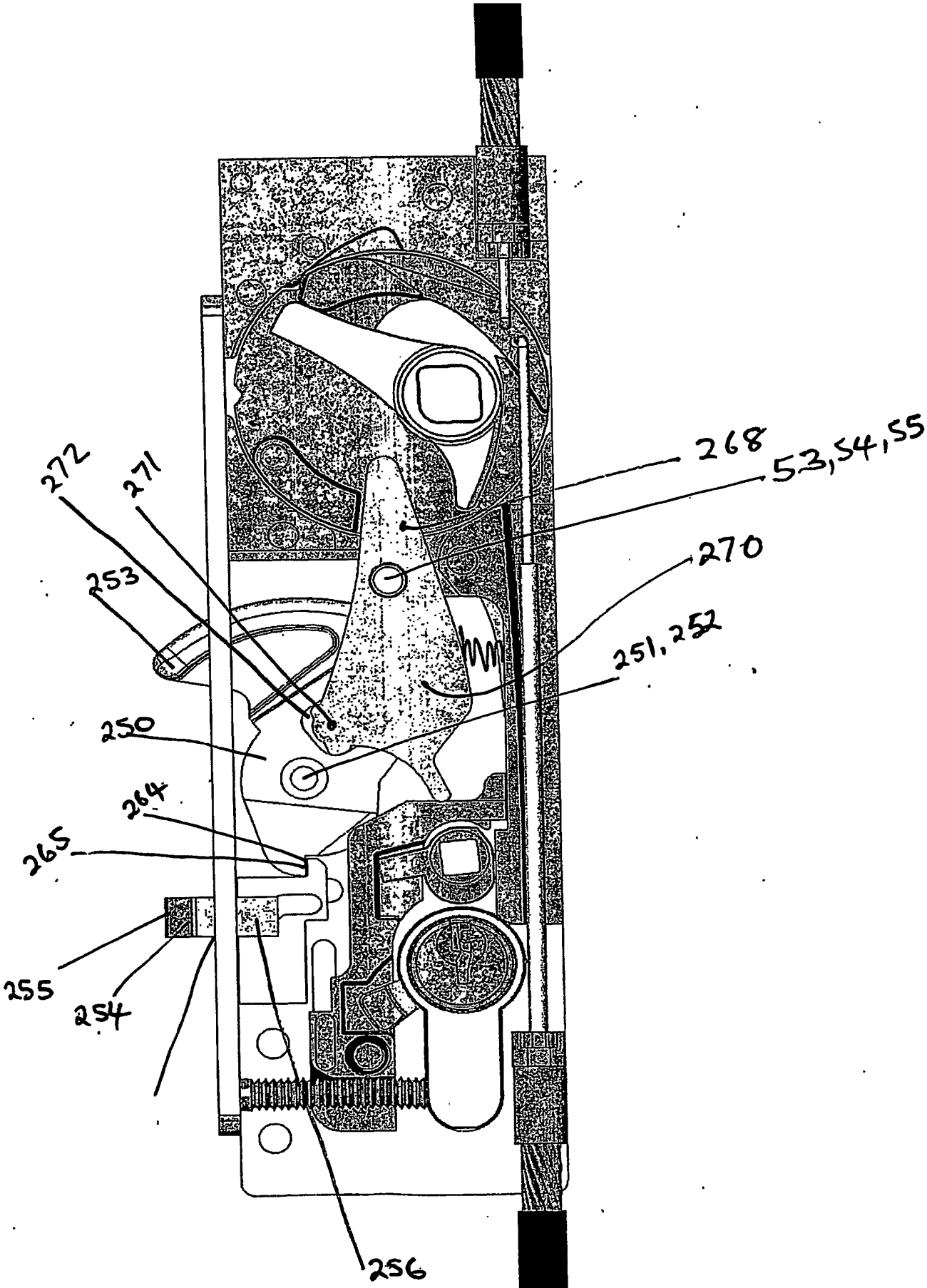


Fig 2 9



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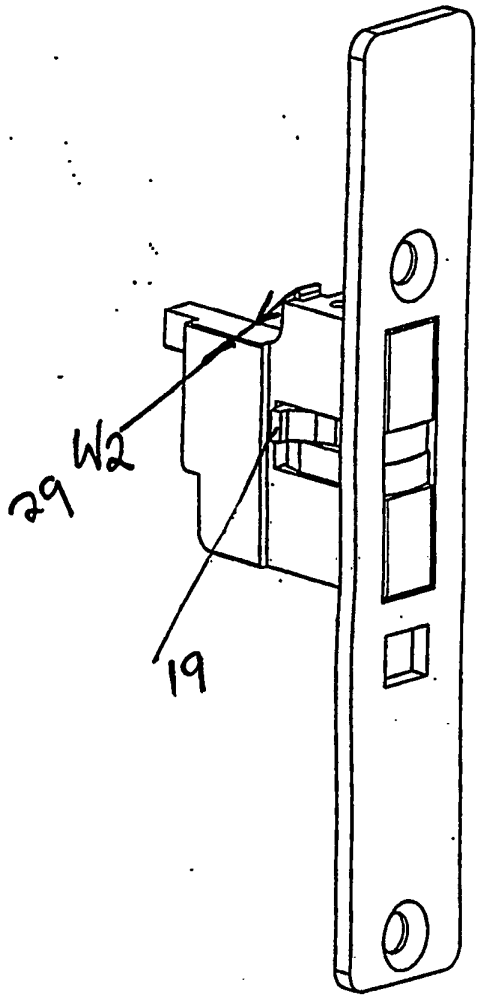

Fig 23
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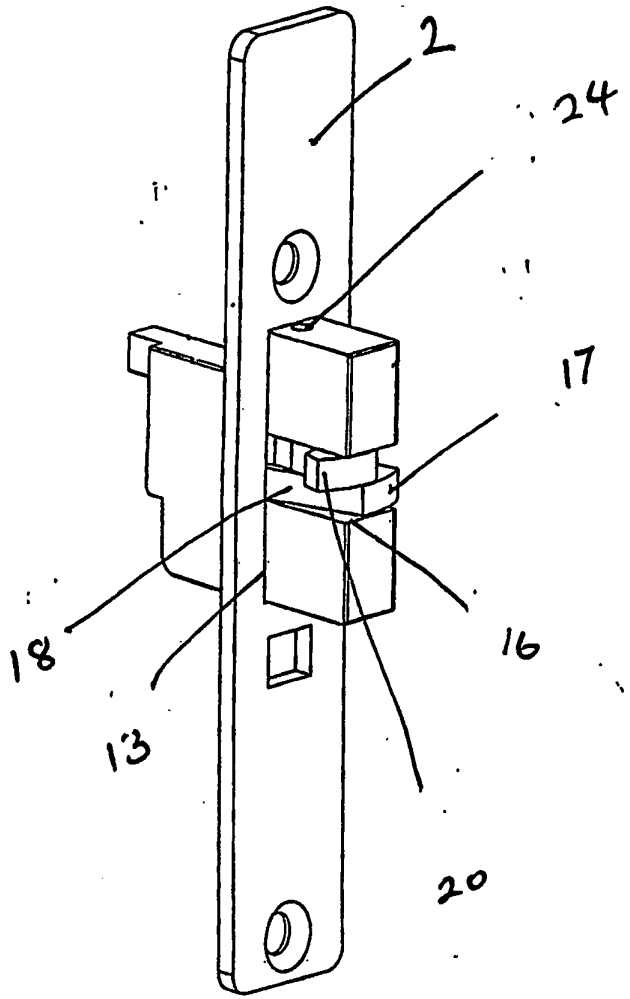

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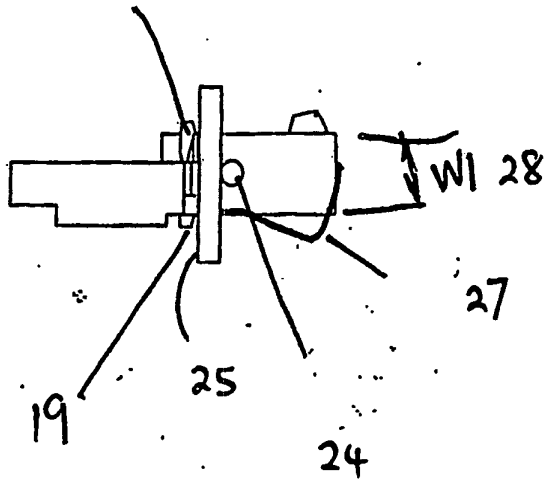

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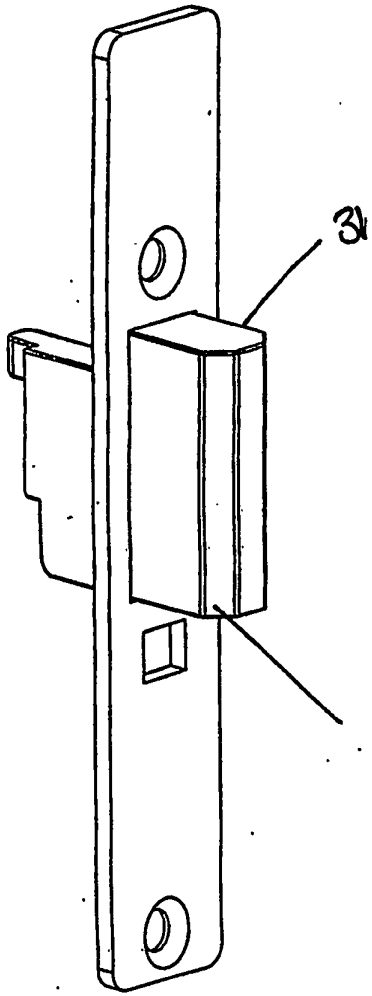

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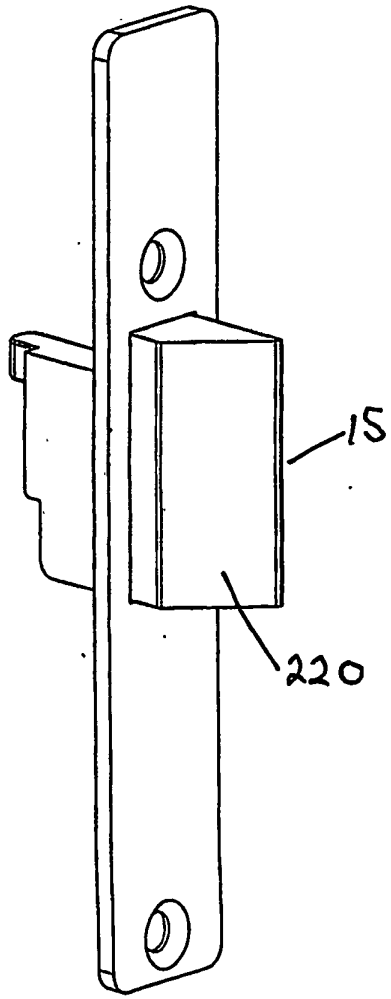

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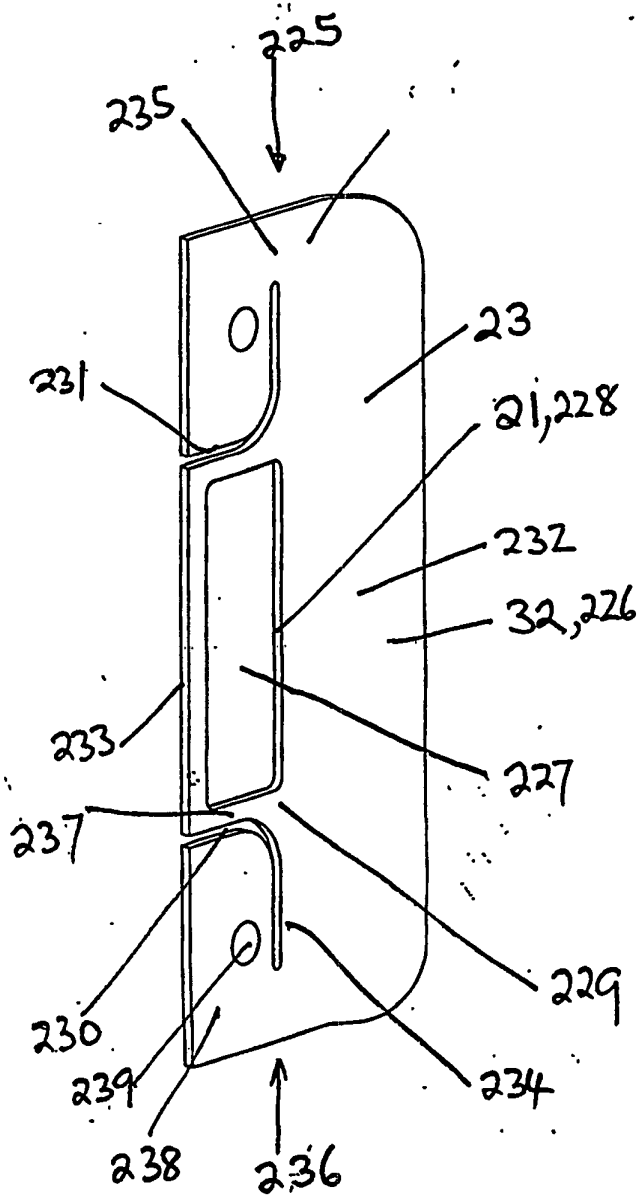

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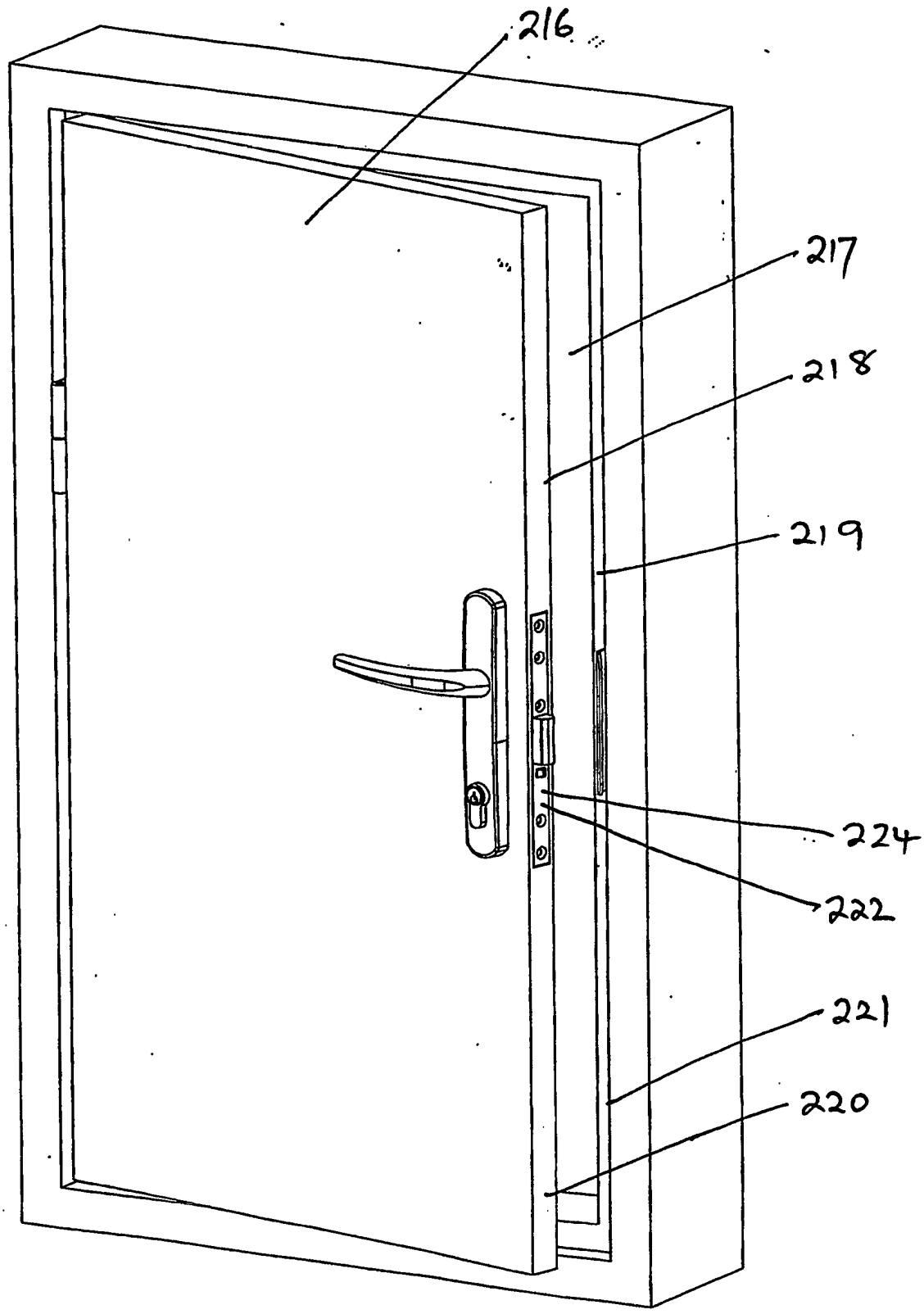

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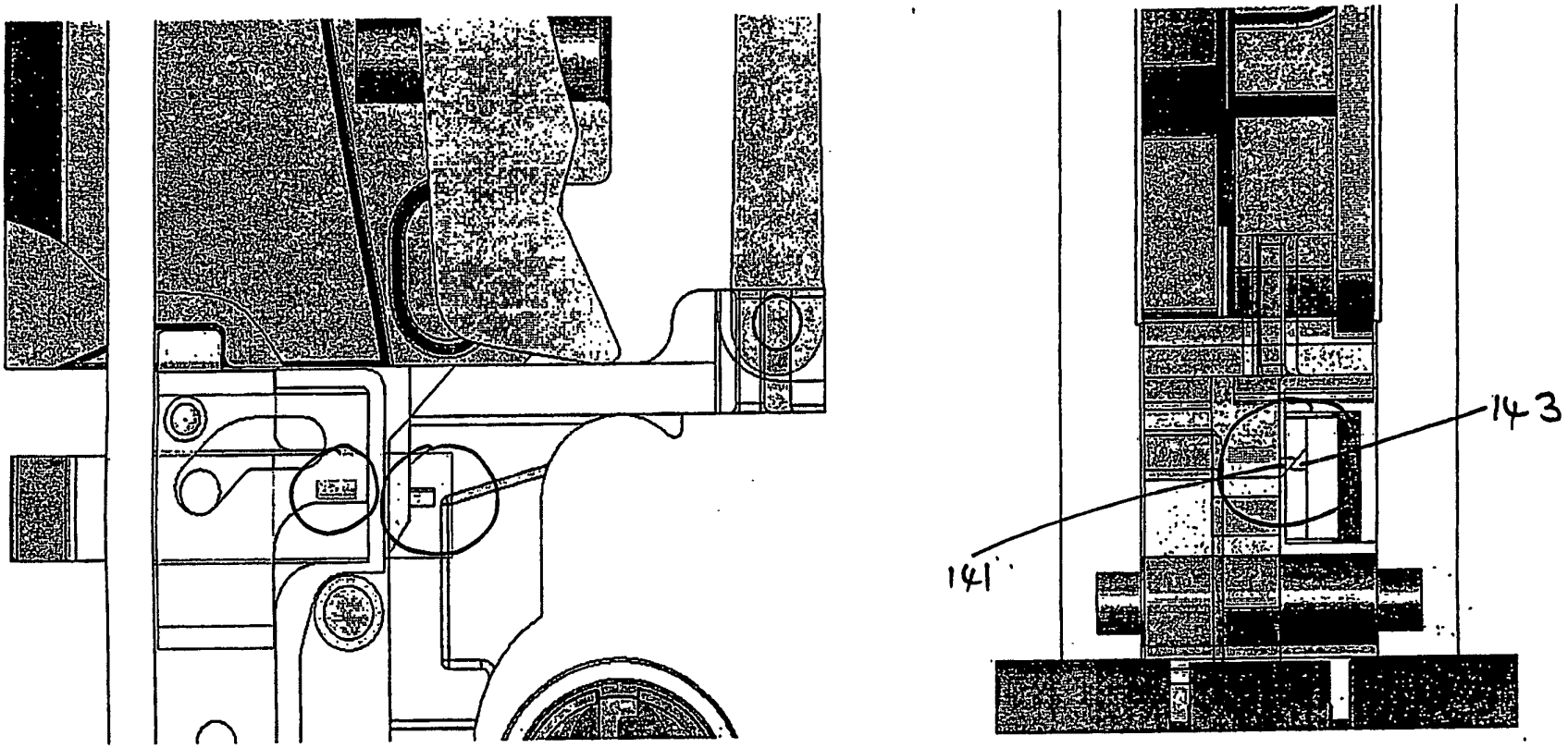
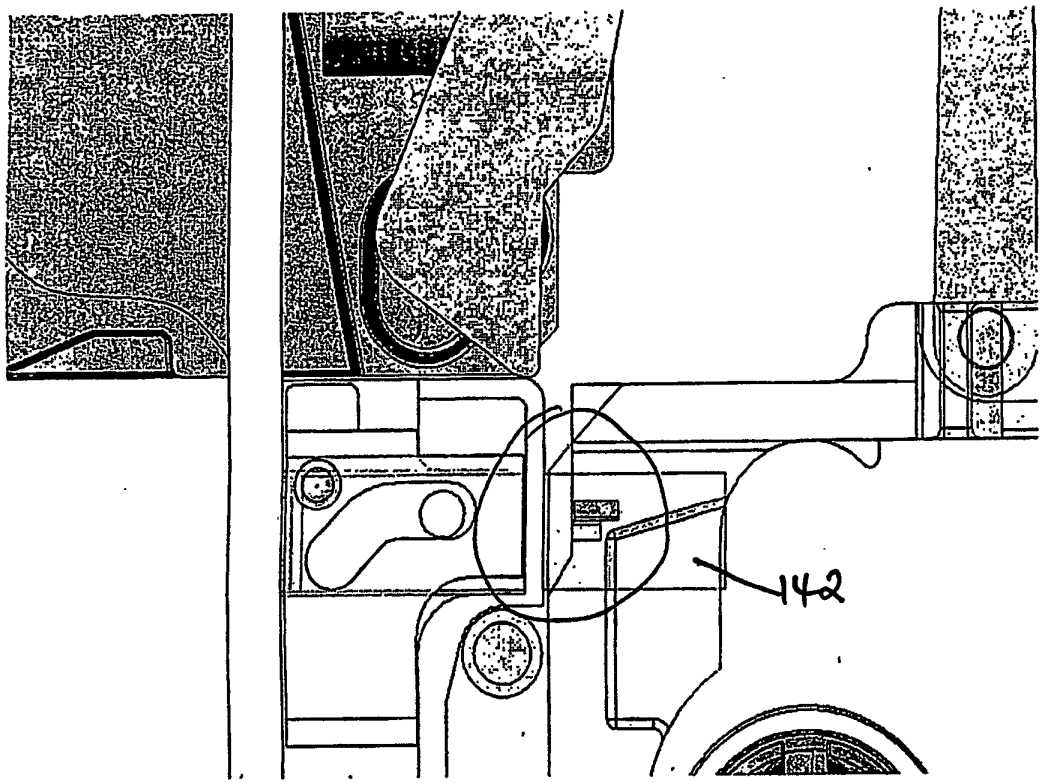
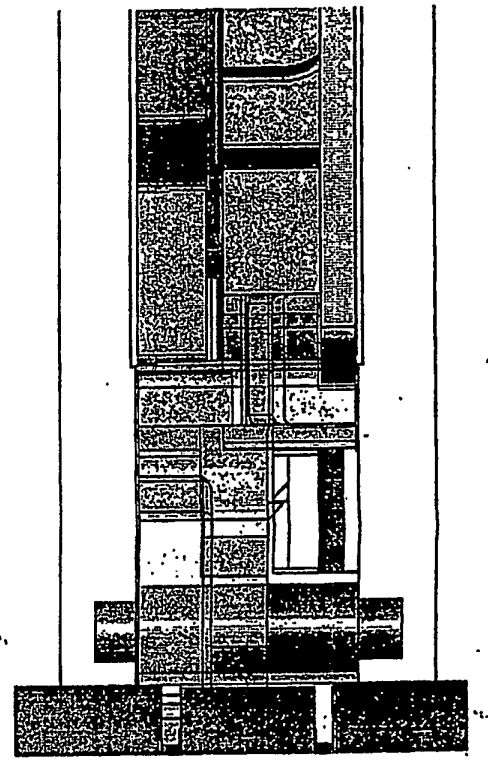


Fig20





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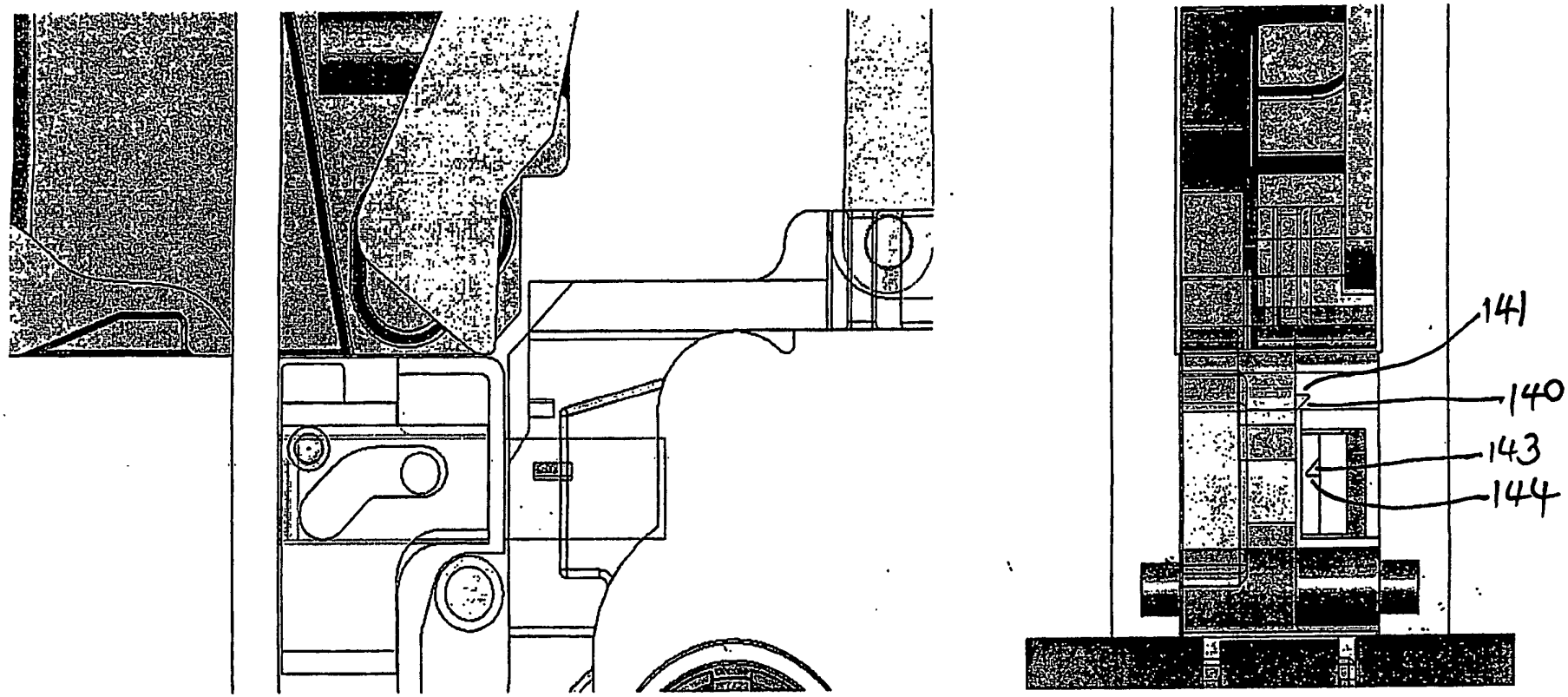


Fig 19.1

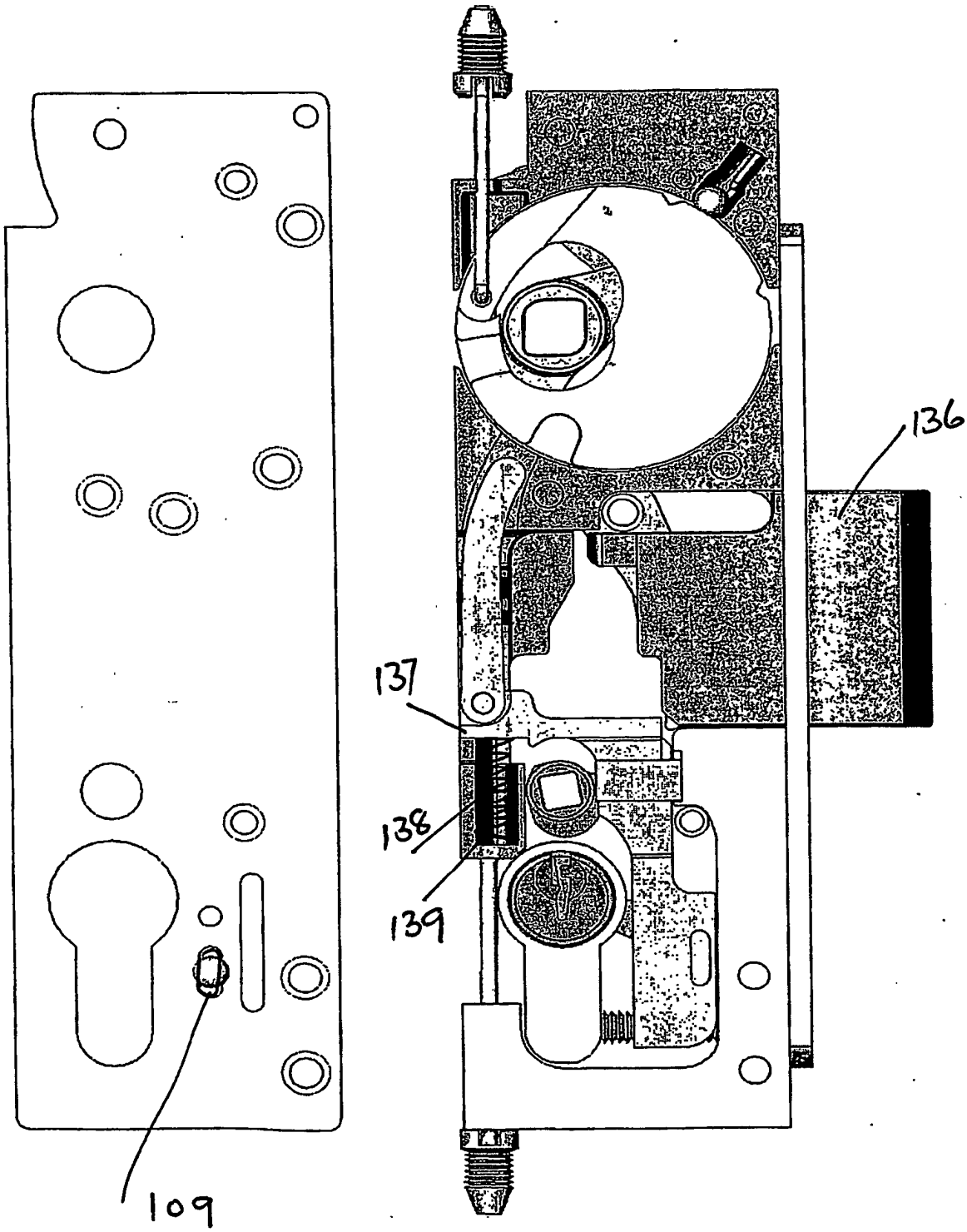
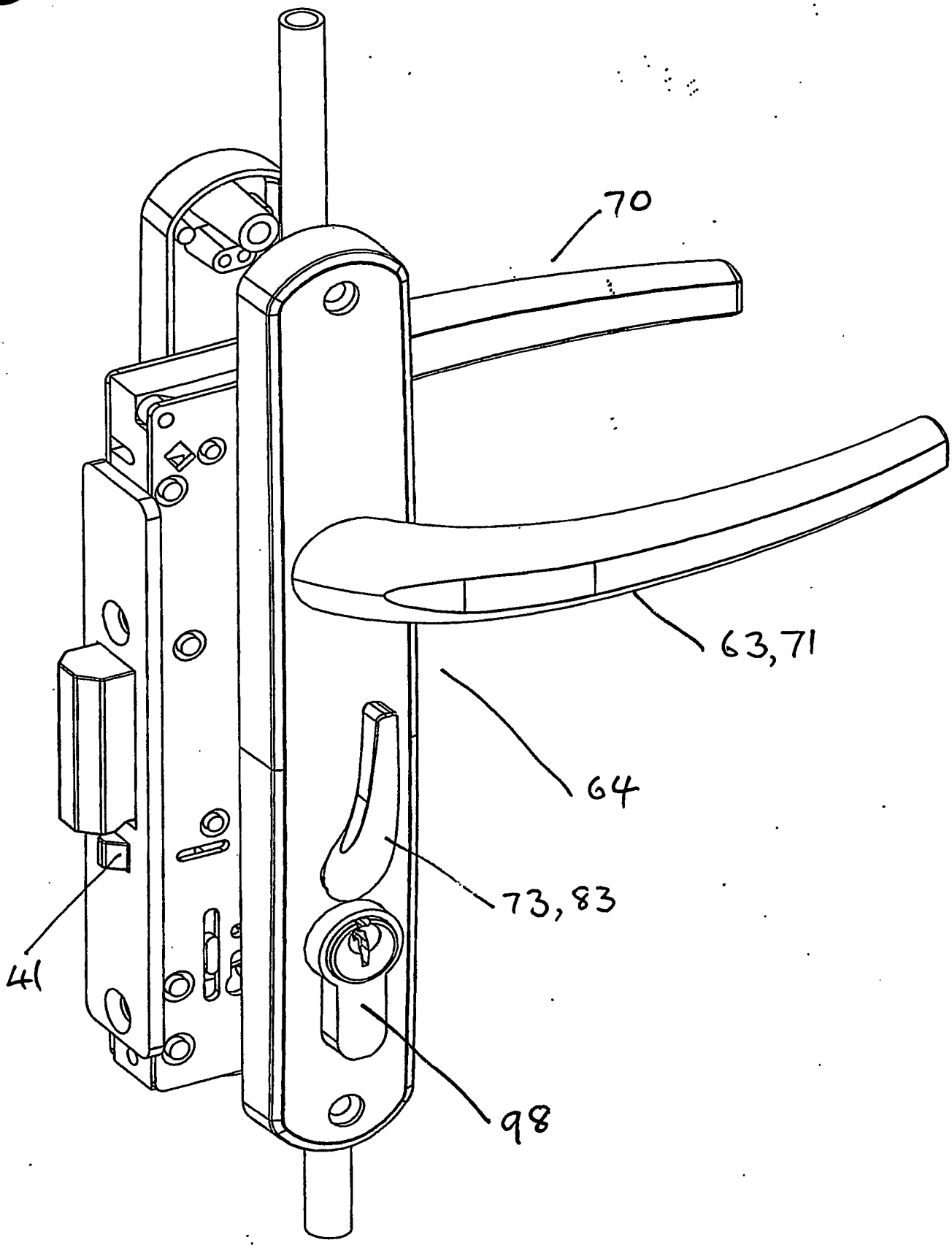


Fig ~~19~~ 17



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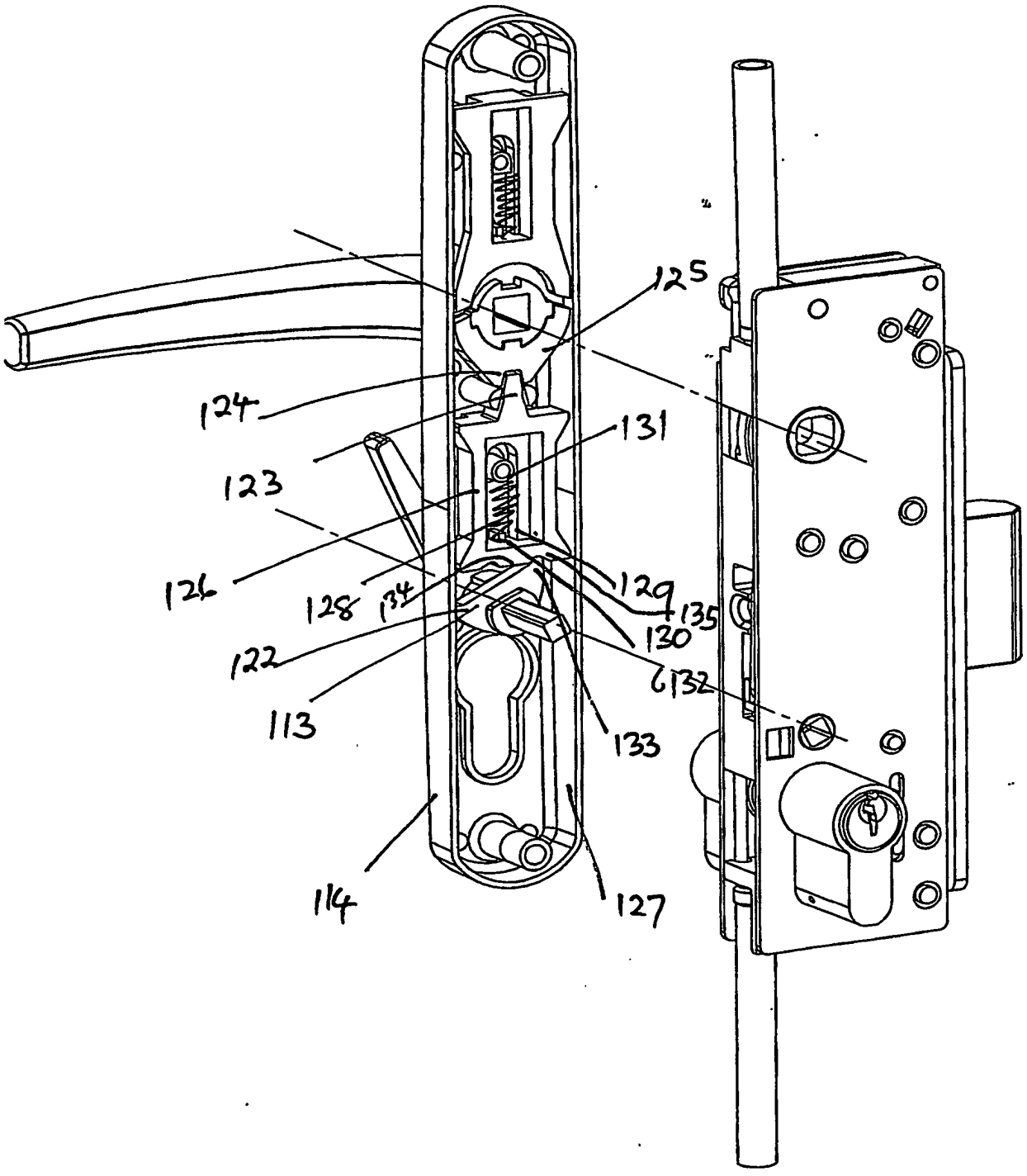

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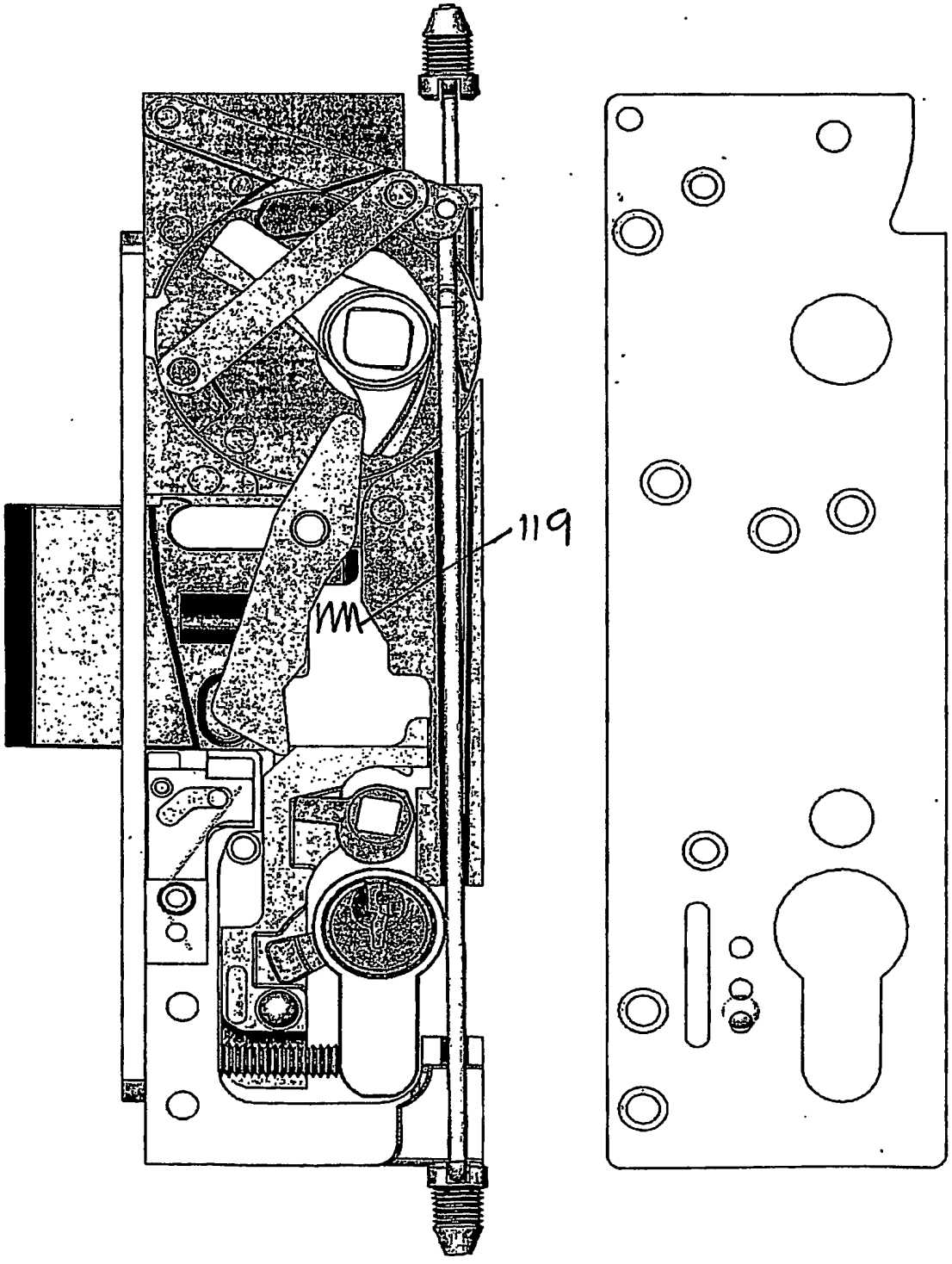

Fig 17
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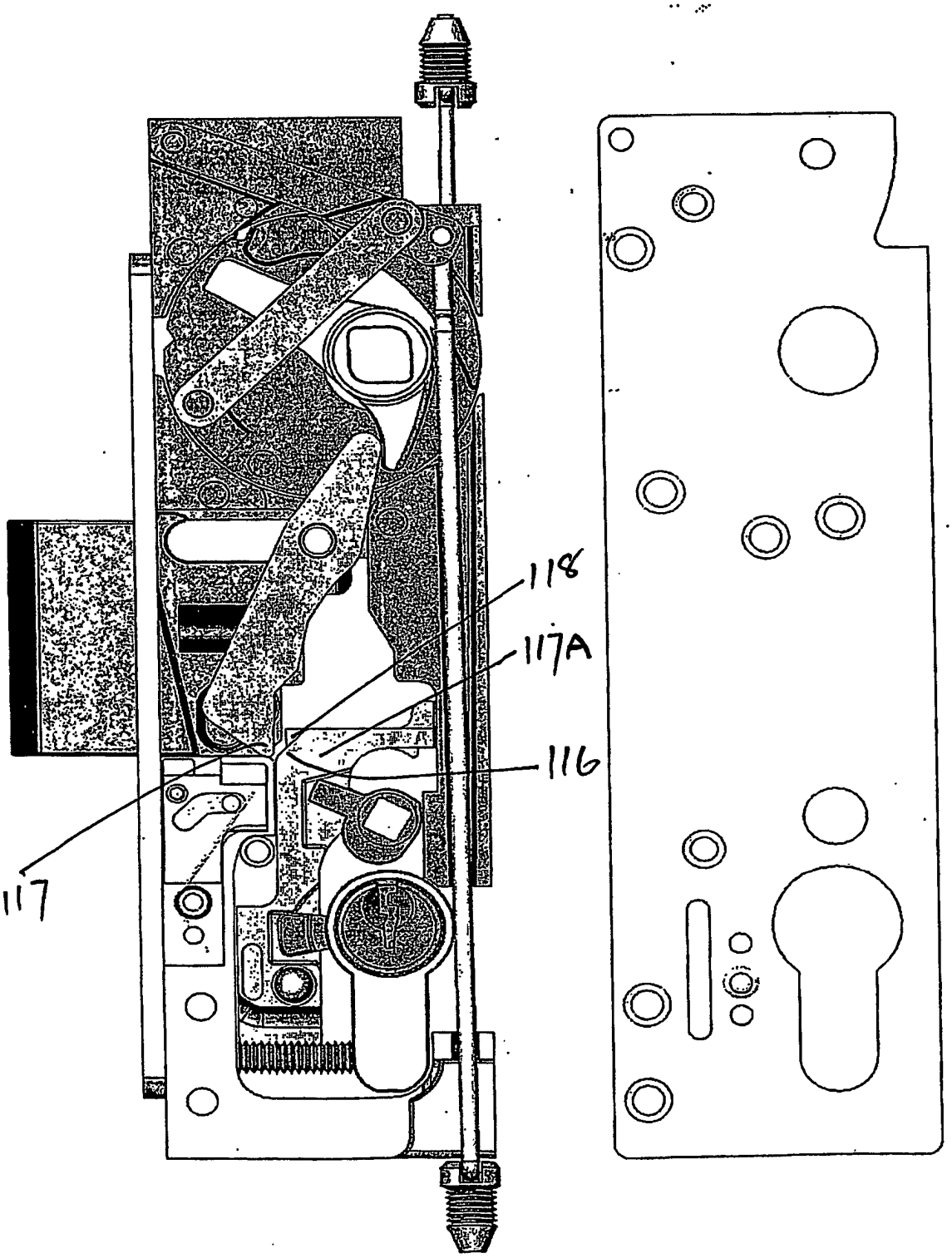

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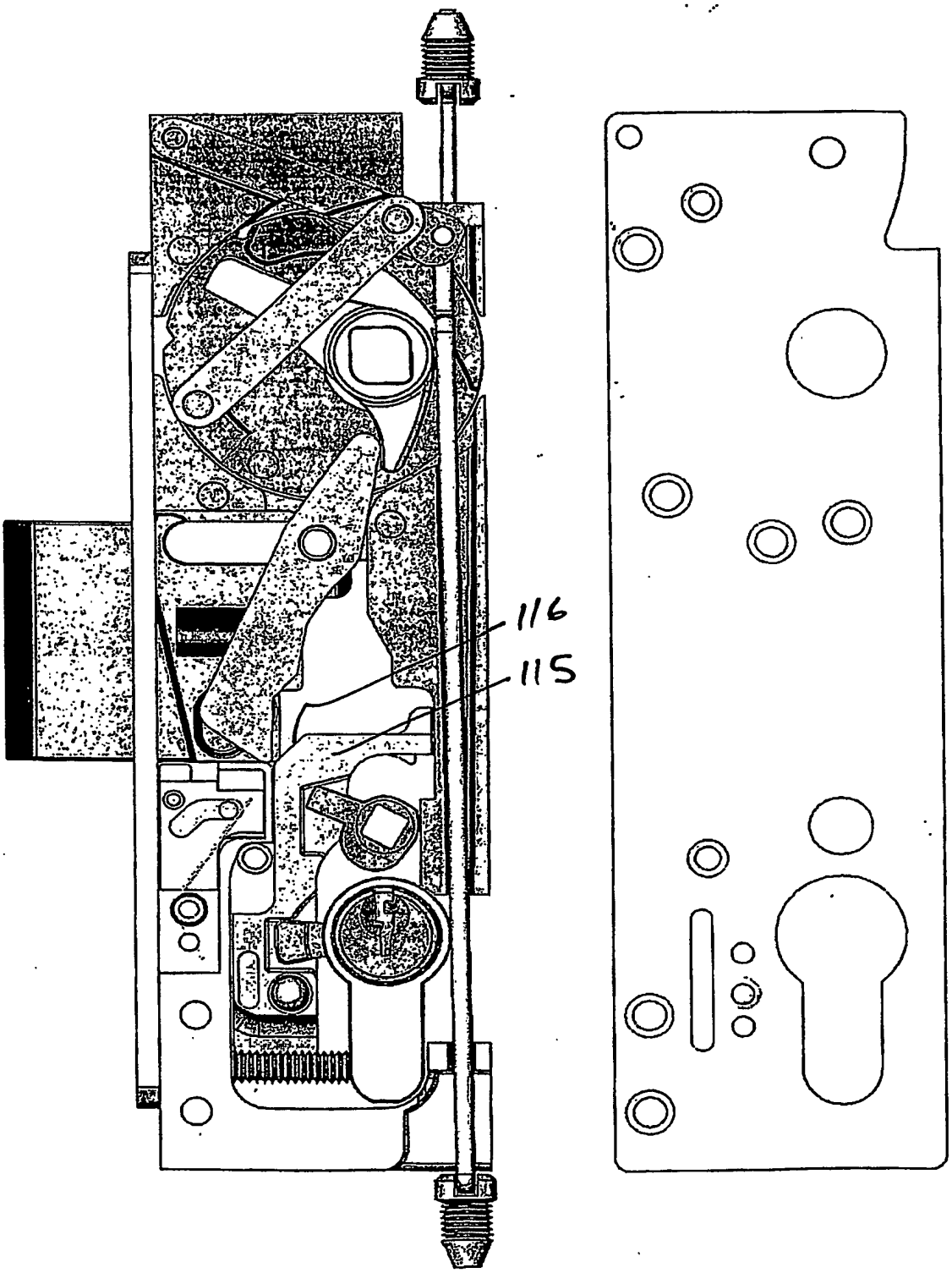

Fig 13

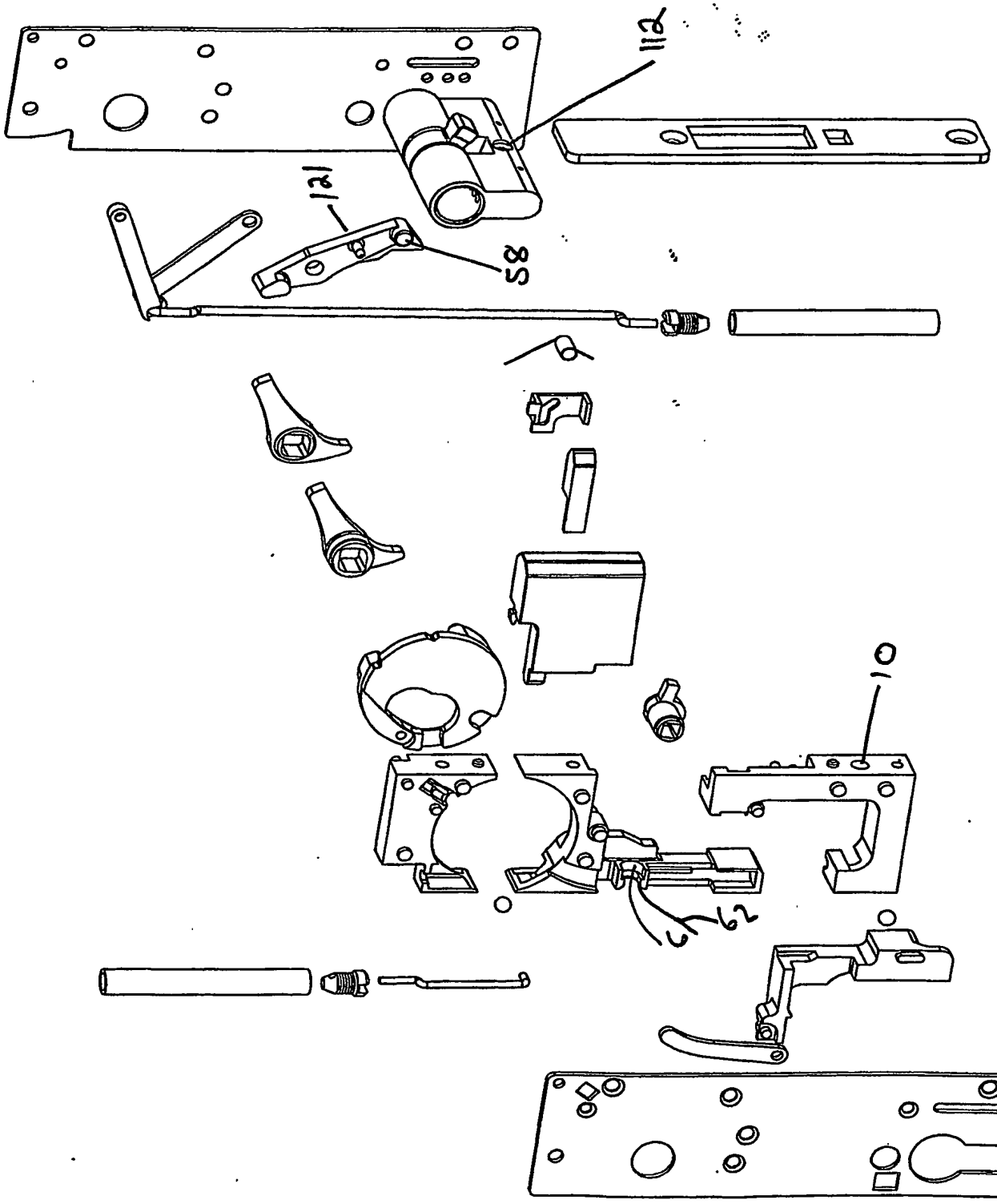

Fig 14
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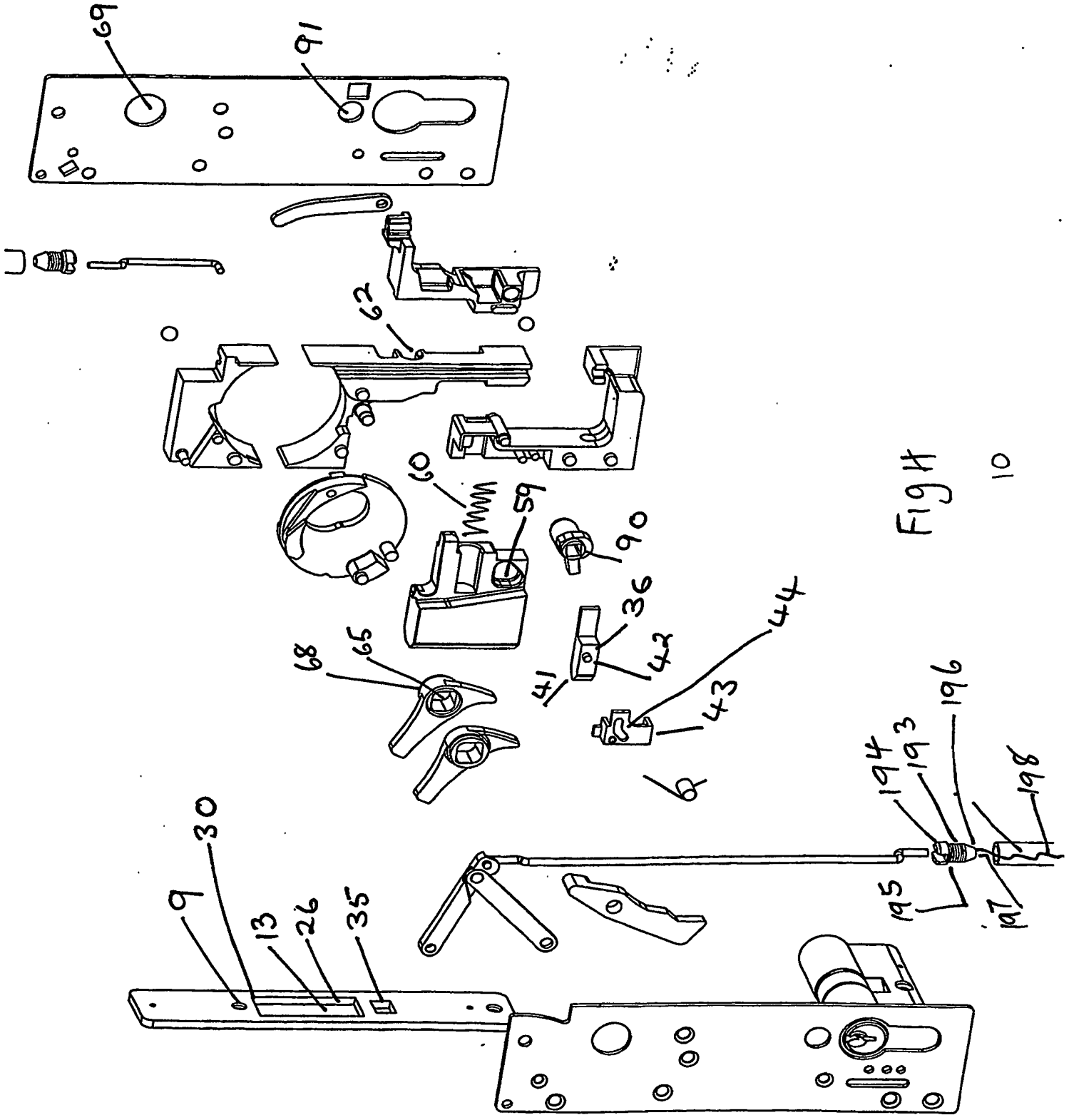
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Fig H

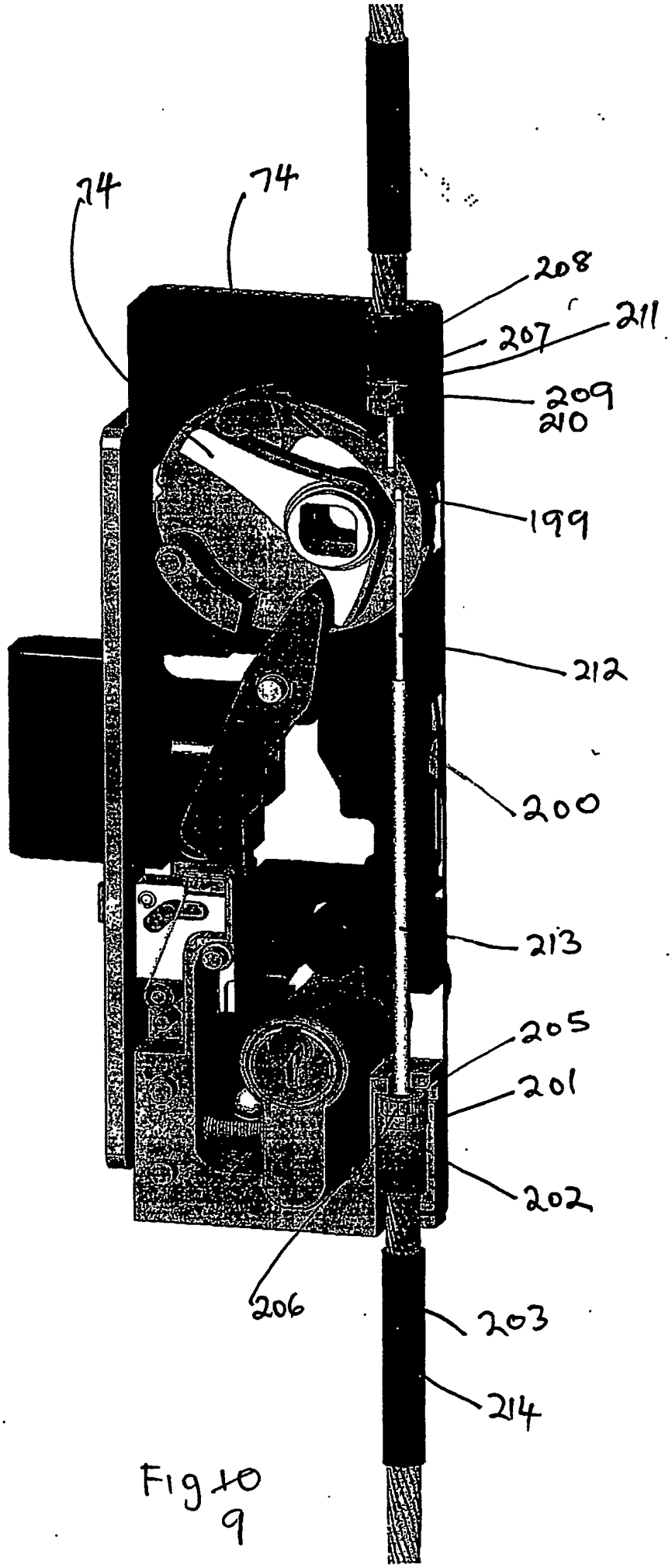


Fig 10

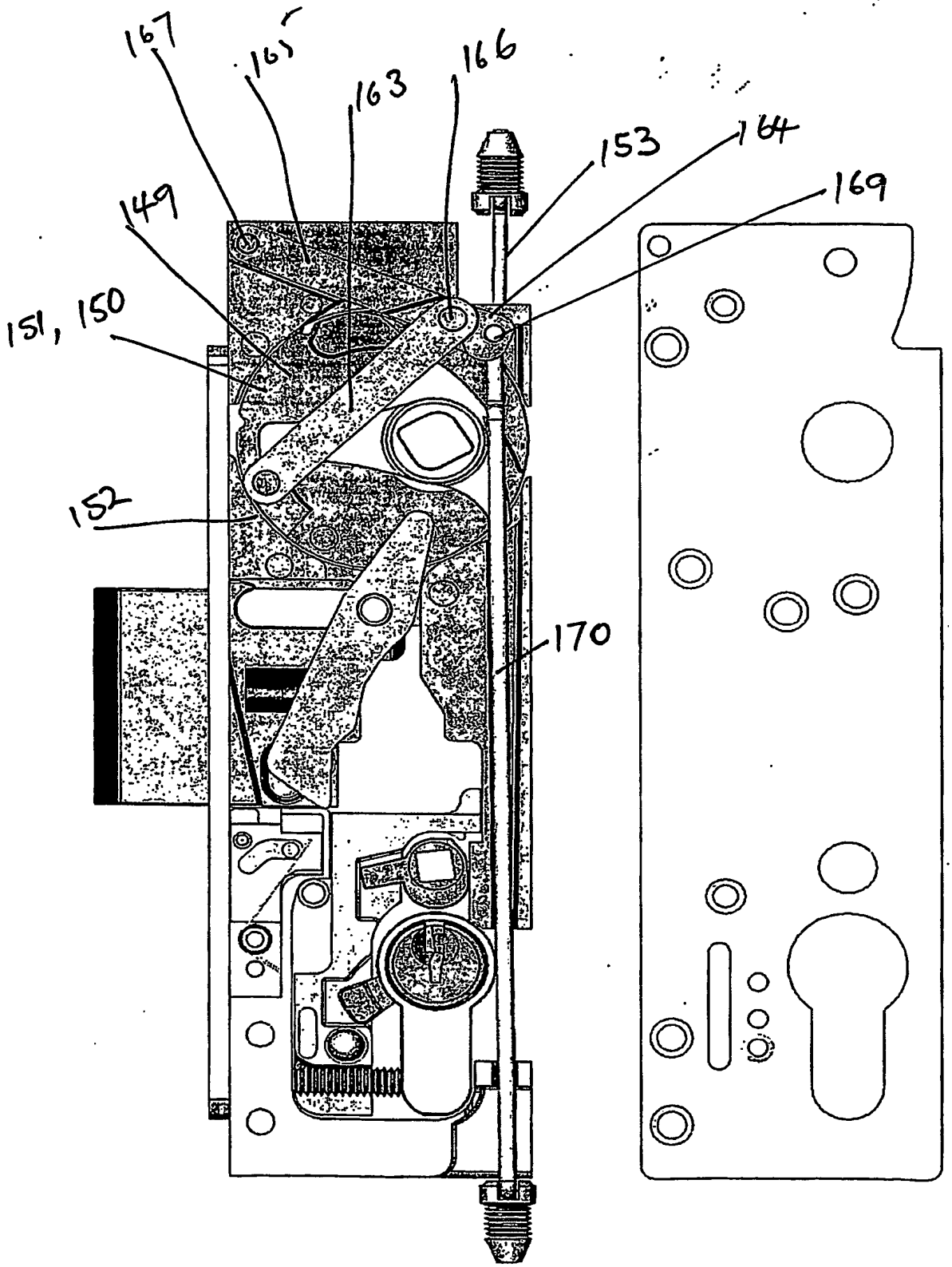


Fig 8

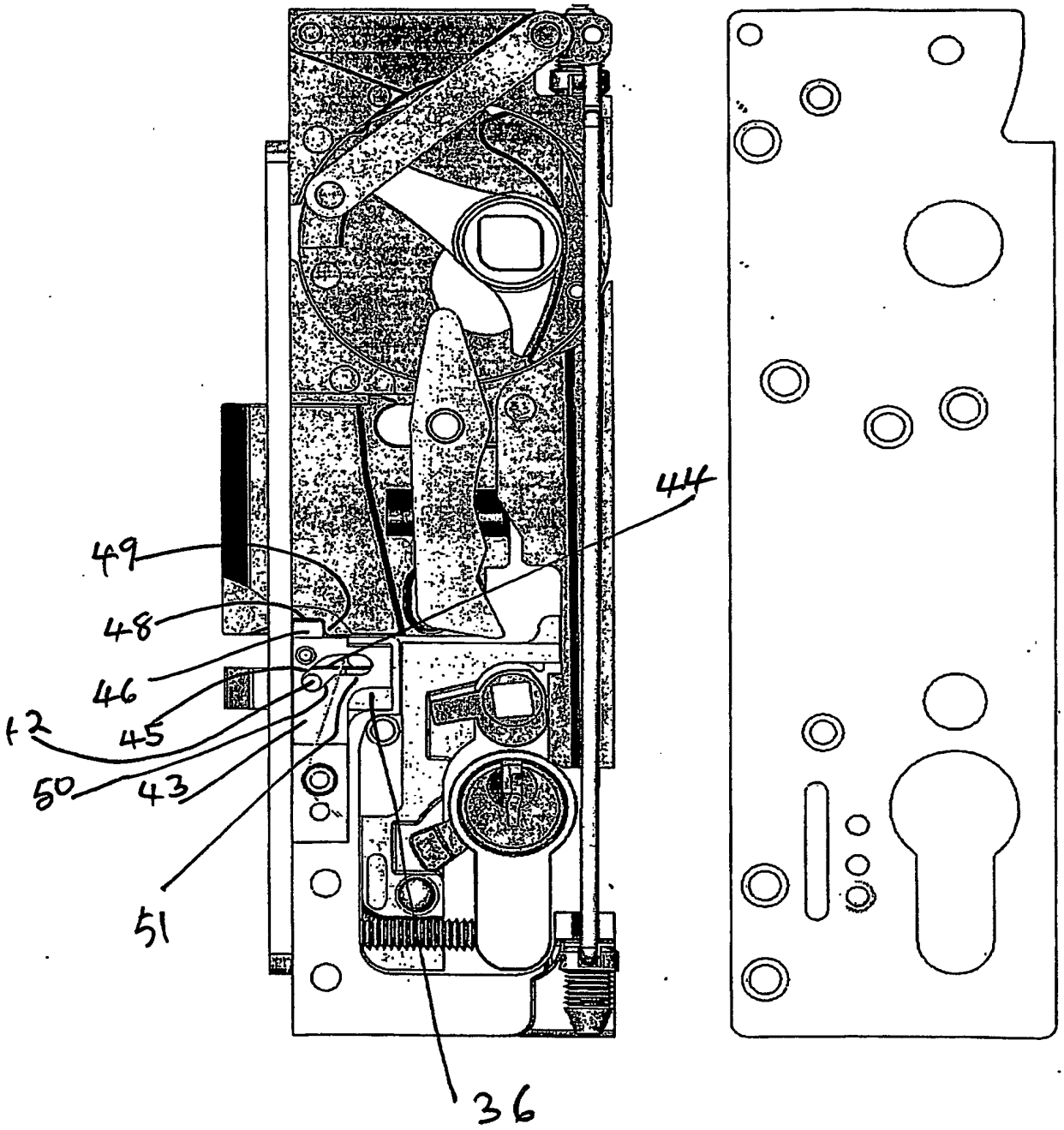
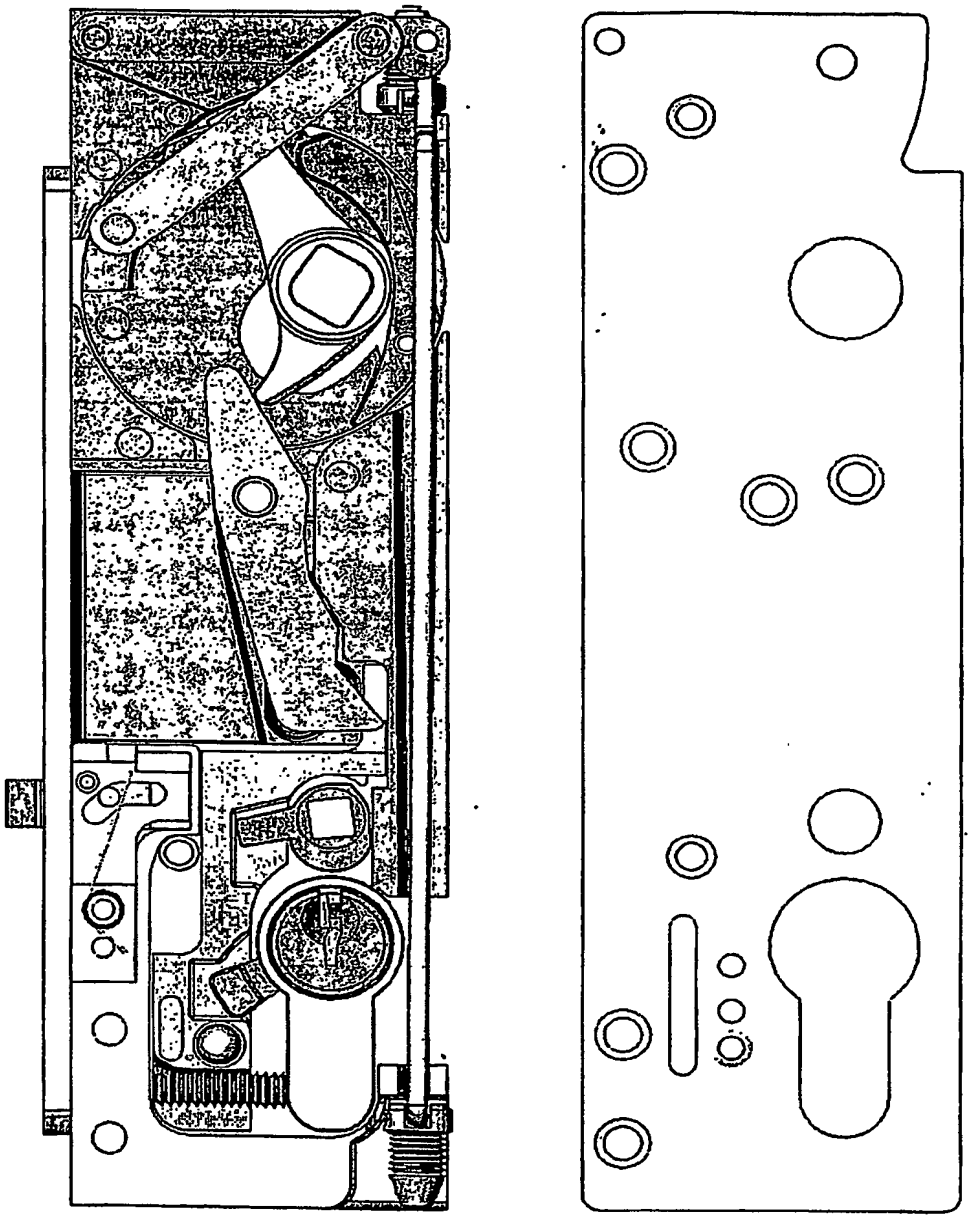


Fig7



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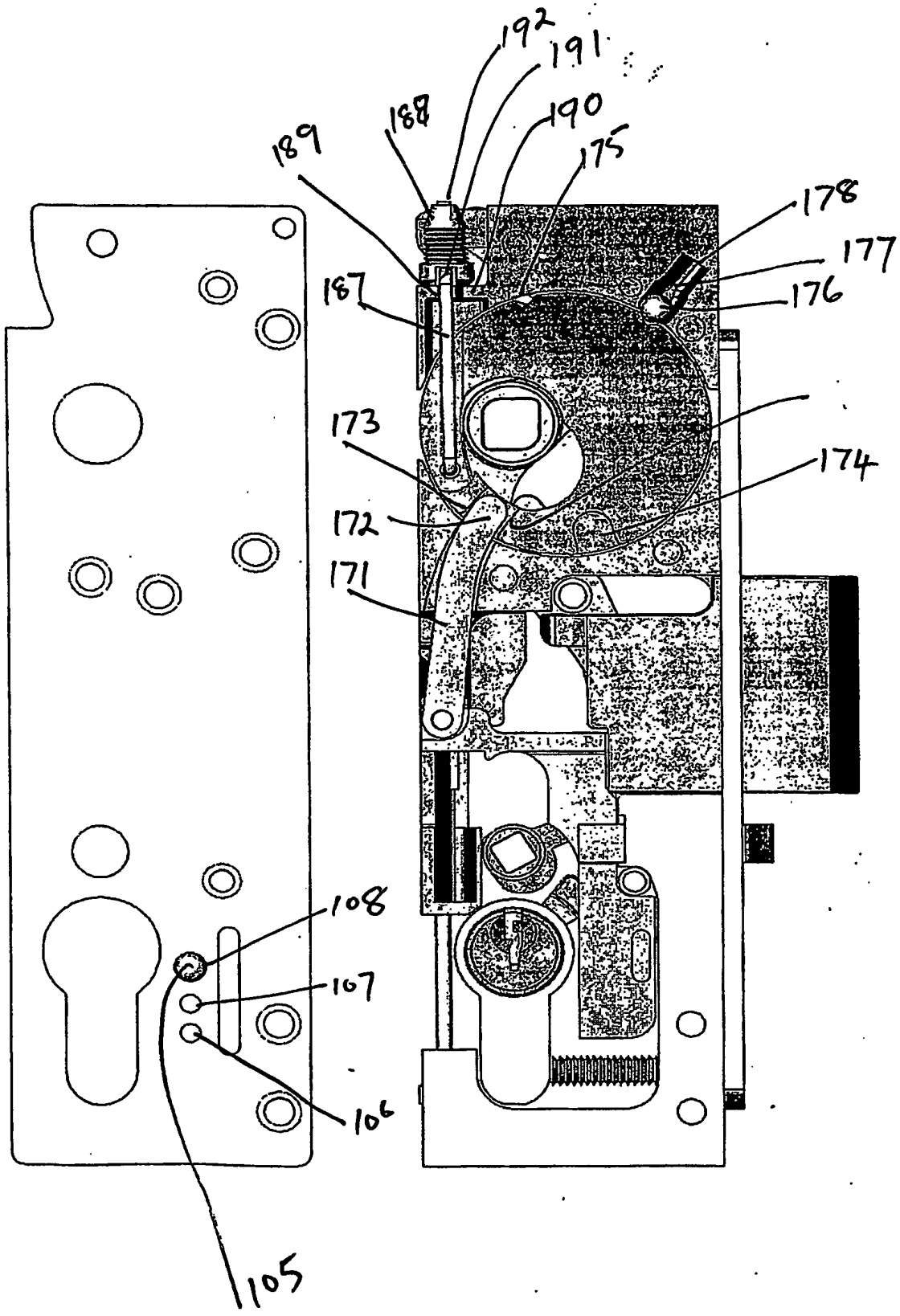
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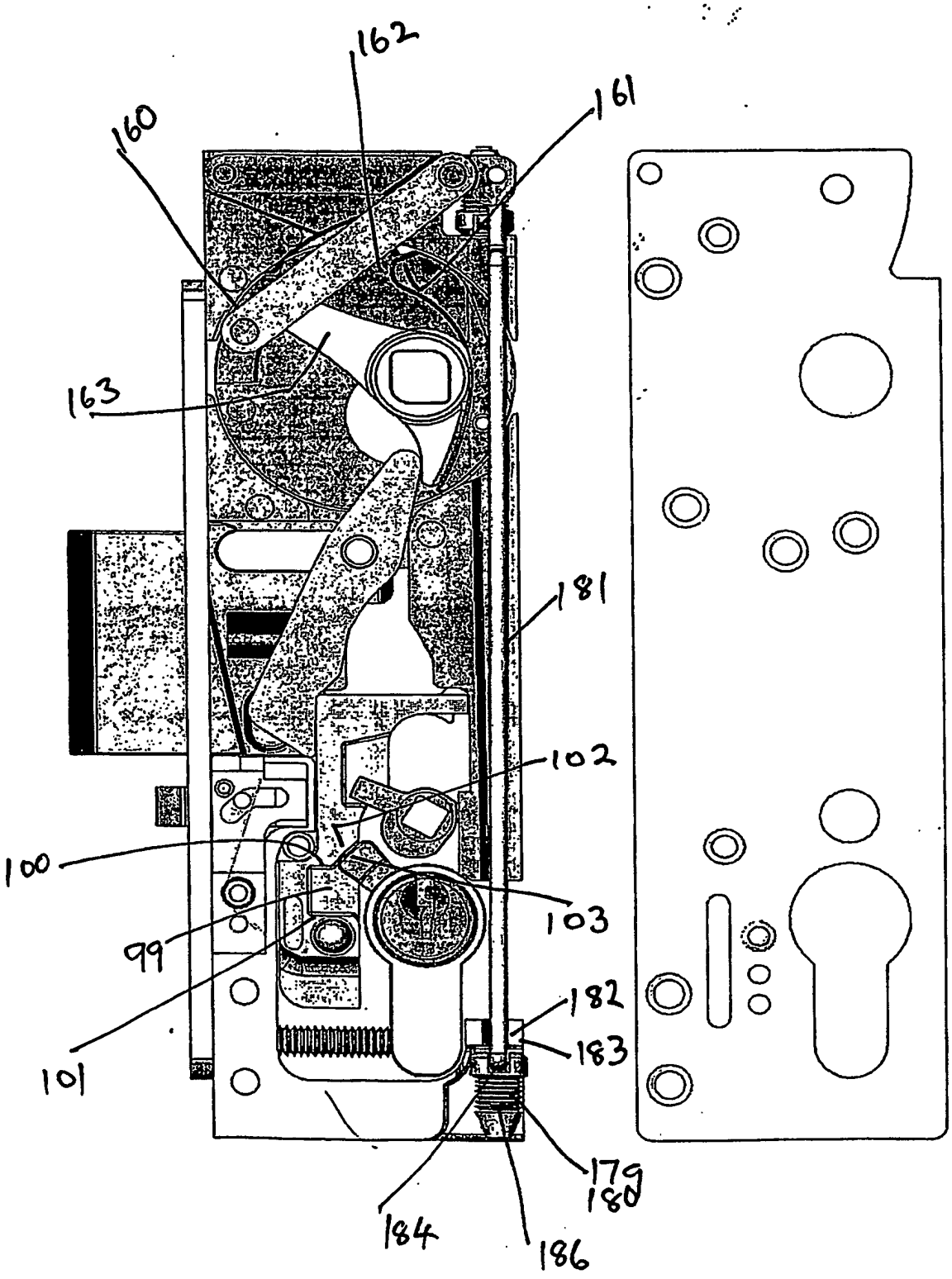
Fig 5



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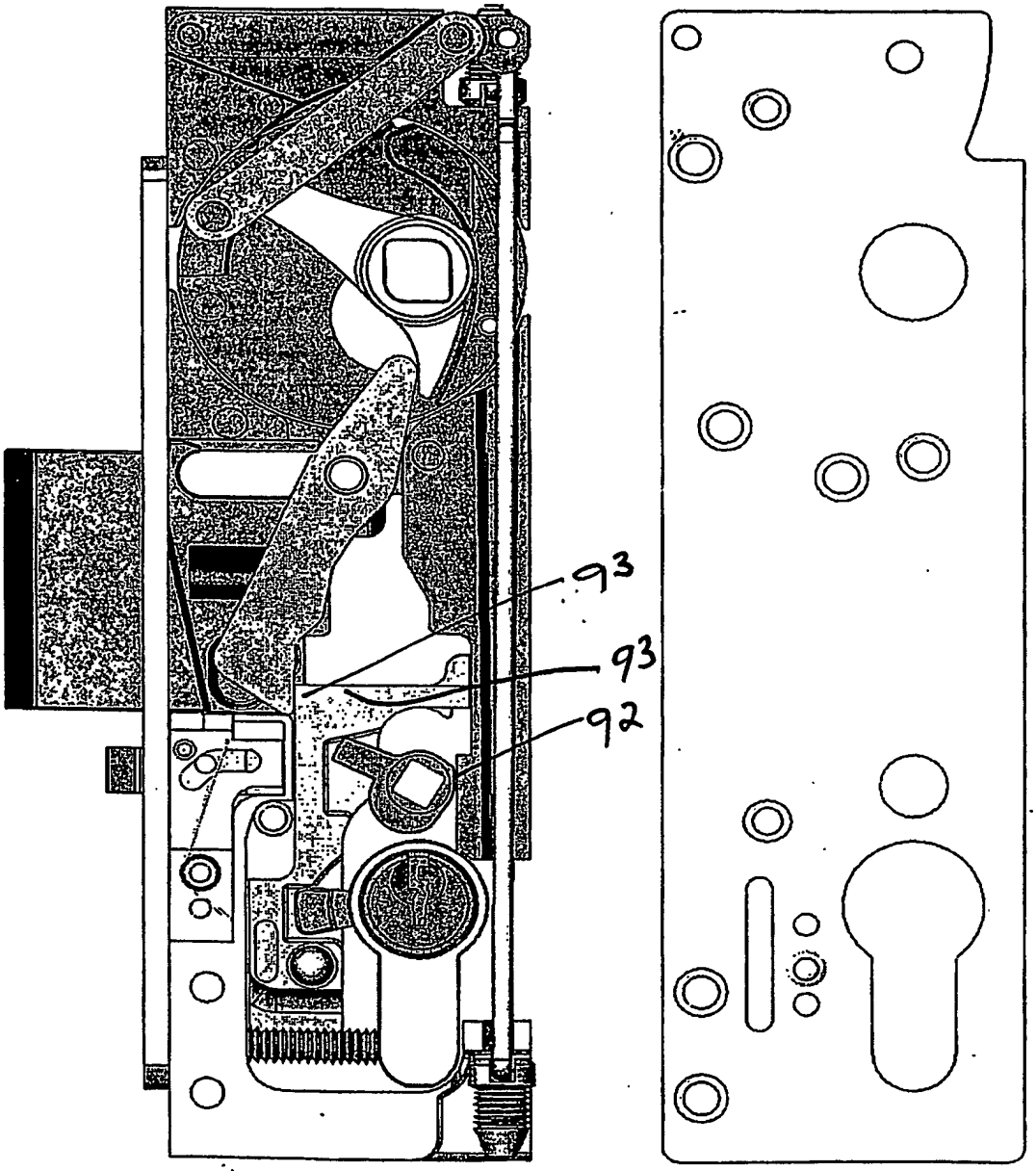

Fig 3

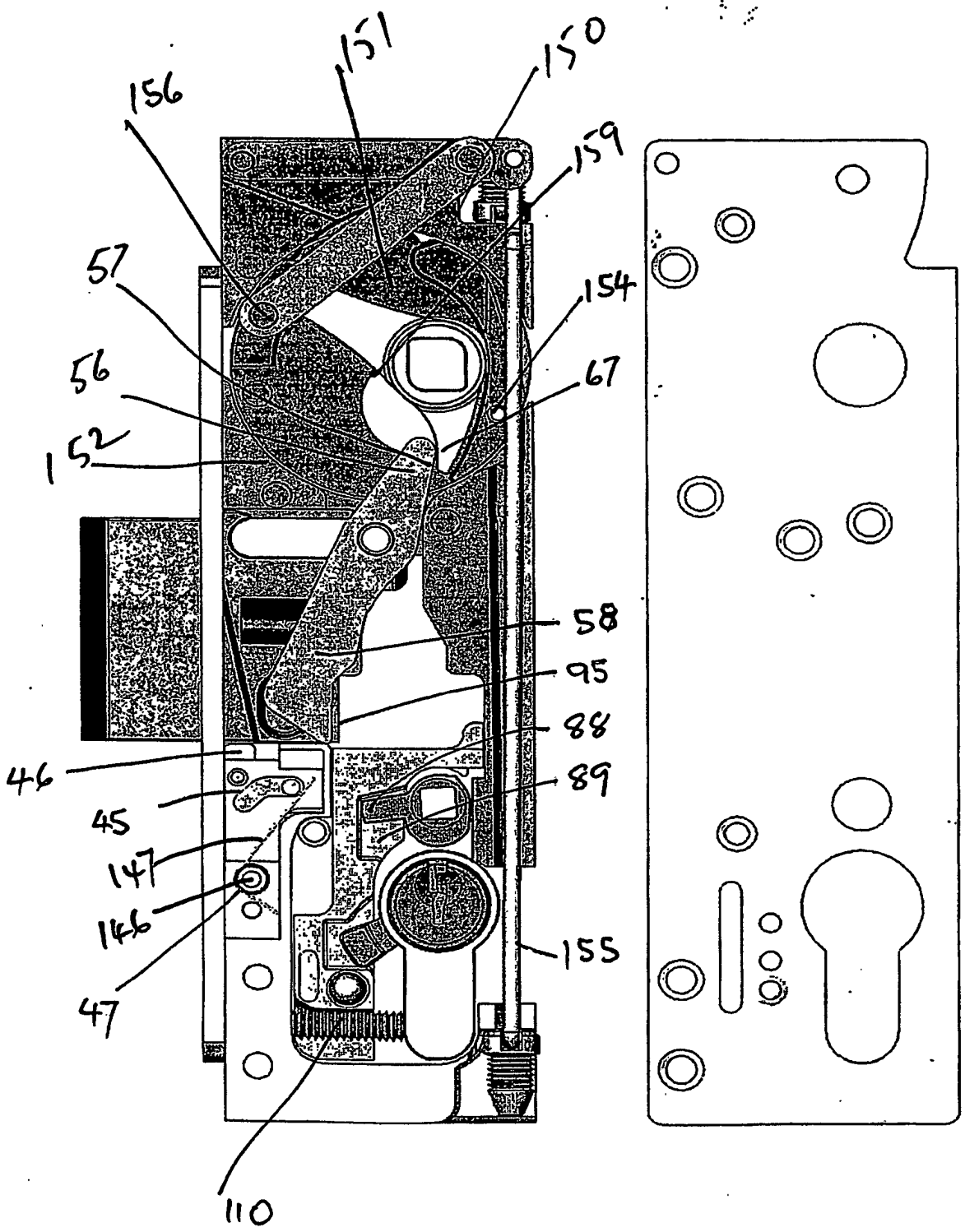
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Fig 2

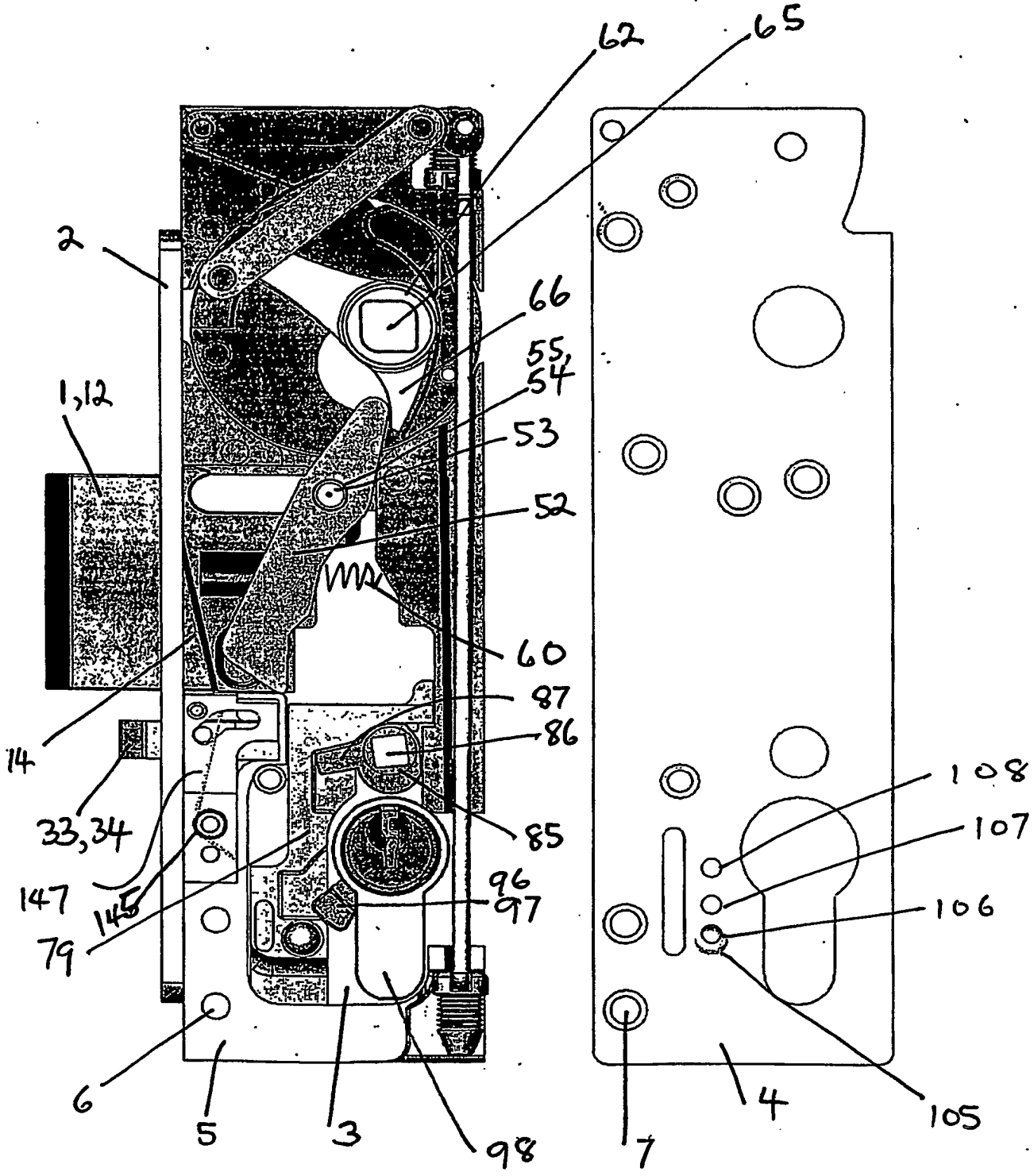
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Fig 1